## M120 Internet Router

# PIC Guide

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This guide provides an overview and description of the Physical Interface Cards (PICs) supported by the Juniper Networks M120 Internet router. The PICs are described alphabetically. Table 1 on page 3 lists the PICs supported by the M120 Internet router by PIC family.

PICs provide the physical connection to various network media types. The PICs are mounted on Flexible PIC Concentrators (FPCs), which are inserted into a slot in a router. A PIC typically occupies a single slot on an FPC. PICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each PIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received from the FPCs. Each PIC is equipped with a media-specific ASIC that performs control functions tailored to the PIC's media type. For complete information about installing PICs and transceivers, see the *PIC and Transceiver Installation Instructions* located at http://www.juniper.net/techpubs/.

Blank PICs resemble other PICs but do not provide any physical connection or activity. When a slot is not occupied by a PIC, you must insert a blank PIC to fill the empty slot and ensure proper cooling of the system.

M120 routers support the Type 1, Type 2, and Type 3 FPCs listed in Table 2 on page 6 and the Compact FPCs (cFPCs) listed in Table 3 on page 6. Table 6 on page 9 provides a PIC/FPC compatibility matrix for the supported PICs for the M120 router.

For a complete list of end-of-life FPCs and end-of-life Enhanced FPCs for M-series and T-series routing platforms, see the *M-series and T-series Routing Platform End-of-Life FPC Guide* located at http://www.juniper.net/techpubs/.

**Table 1: PICs Supported by the M120 Internet Router**

| PIC Family and Type | Ports | First JUNOS Support | Page |
|---|---|---|---|
| **ATM2 IQ** | | | |
| ATM2 DS3 IQ | 4 | 8.0R2 | 20 |
| ATM2 E3 IQ | 4 | 8.0R2 | 22 |
| ATM2 OC3/STM1 IQ | 2 | 8.0R2 | 24 |
| ATM2 OC12/STM4 IQ | 1 | 8.0R2 | 27 |
| ATM2 OC12/STM4 IQ | 2 | 8.0R2 | 27 |
| ATM2 OC48/STM16 IQ with SFP | 1 | 8.0R2 | 30 |
| **Channelized IQ** | | | |
| Channelized DS3 IQ | 4 | 8.0R2 | 33 |
| Channelized E1 IQ | 10 | 8.0R2 | 35 |
| Channelized OC3 IQ | 1 | 8.0R2 | 37 |
| Channelized OC12 IQ | 1 | 8.0R2 | 40 |
| Channelized STM1 IQ | 1 | 8.0R2 | 43 |
| Channelized T1 IQ | 10 | 8.0R2 | 45 |
| **DS3, E1, E3, and T1** | | | |
| DS3 | 4 | 8.0R2 | 48 |
| E1 | 4 | 8.0R2 | 50 |
| T1 | 4 | 8.0R2 | 112 |
| **E3 IQ** | | | |
| E3 IQ | 4 | 8.0R2 | 52 |
| **EIA-530** | | | |
| EIA-530 | 2 | 8.0R2 | 54 |
| **Fast Ethernet** | | | |
| Fast Ethernet | 4 | 8.0R2 | 56 |
| Fast Ethernet | 8 | 8.0R2 | 56 |
| Fast Ethernet | 12 | 8.0R2 | 56 |
| Fast Ethernet | 48 | 8.0R2 | 56 |
| **Gigabit Ethernet** | | | |
| 10-Gigabit Ethernet with XENPAK | 1 | 8.0R2 | 73 |

**Table 1: PICs Supported by the M120 Internet Router** *(continued)*

| PIC Family and Type | Ports | First JUNOS Support | Page |
|---|---|---|---|
| 10-Gigabit Ethernet DWDM | 1 | 8.0R2 | 78 |
| Gigabit Ethernet with SFP | 1 | 8.0R2 | 60 |
| Gigabit Ethernet with SFP | 2 | 8.0R2 | 60 |
| Gigabit Ethernet with SFP | 4 | 8.0R2 | 60 |
| Gigabit Ethernet with SFP | 10 | 8.0R2 | 60 |
| **Ethernet IQ** | | | |
| Gigabit Ethernet IQ with SFP | 1 | 8.0R2 | 63 |
| Gigabit Ethernet IQ with SFP | 2 | 8.0R2 | 63 |
| **Ethernet IQ2** | | | |
| Gigabit Ethernet IQ2 with SFP | 4 | 8.0R2 | 66 |
| Gigabit Ethernet IQ2 with SFP | 8 | 8.0R2 | 66 |
| Gigabit Ethernet IQ2 with SFP | 8 | 8.5 | 66 |
| 10-Gigabit Ethernet IQ2 with XFP | 1 | 8.2 | 70 |
| **Services** | | | |
| Adaptive Services II | 0 | 8.0R2 | 12 |
| Adaptive Services II Layer 2 Services | 0 | 8.0R2 | 17 |
| Adaptive Services II FIPS | 0 | 8.0R2 | 15 |
| MultiServices 100 | 0 | 8.2R2 | 80 |
| MultiServices 400 | 0 | 8.2 | 80 |
| MultiServices 500 | 0 | 8.3 | 80 |
| Tunnel Services | 0 | 8.0R2 | 114 |
| Tunnel Services | 0 | 8.0R2 | 114 |
| Tunnel Services | 0 | 8.0R2 | 114 |
| **SONET/SDH** | | | |
| SONET/SDH OC3c/STM1 | 4 | 8.0R2 | 83 |
| SONET/SDH OC3/STM1 (Multi-Rate) with SFP | 4 | 8.4 | 87 |
| SONET/SDH OC3/STM1 (Multi-Rate) with SFP | 4 | 8.3 | 87 |

**Table 1: PICs Supported by the M120 Internet Router** *(continued)*

| PIC Family and Type | Ports | First JUNOS Support | Page |
|---|---|---|---|
| SONET/SDH OC12c/STM4 | 1 | 8.0R2 | 91 |
| SONET/SDH OC12/STM4 (Multi-Rate) with SFP | 1 | 8.4 | 94 |
| SONET/SDH OC12/STM4 (Multi-Rate) with SFP | 4 | 8.3 | 94 |
| SONET/SDH OC48c/STM16 with SFP | 4 | 8.0R2 | 99 |
| SONET/SDH OC48 /STM16 (Multi-Rate) with SFP | 1 | 8.3 | 103 |
| SONET/SDH OC192c/STM64 PIC with XFP | 1 | 8.3 | 108 |

# FPCs and cFPCs Supported

M120 routers support the FPCs listed in Table 2 on page 6.

**Table 2: FPCs Supported by the M120 Router**

| FPC Type | FPC Name | FPC Model Number | Maximum Number of PICs Supported per FPC | Maximum Throughput per FPC | First JUNOS Release |
|---|---|---|---|---|---|
| 1 | FPC1 | M120-FPC1 | 4 | 4 Gbps | 8.0R2 |
| 2 | FPC2 | M120-FPC2 | 4 | 10 Gbps | 8.0R2 |
| 3 | FPC3 | M120-FPC3 | 1 | 10 Gbps | 8.0R2 |

A cFPC is a combination of a PIC and an FPC. It contains the interface circuitry and the FPC as a single assembly. Both cFPCs provide receptacles for XFP optical transceivers. The M120 chassis provides two slots for cFPCs, and supports any combination of cFPC types. M120 routers support the cFPCs listed in Table 3 on page 6.

**Table 3: cFPCs Supported by the M120 Router**

| cFPC Name | cFPC Model Number | Maximum Throughput per cFPC | First JUNOS Release | Connector |
|---|---|---|---|---|
| 10-Gigabit Ethernet | M120-cFPC-1XGE-XFP | 10 Gbps | 8.0R2 | Duplex LC/PC (Rx and Tx) |
| SONET/SDH OC192/STM64 | M120-cFPC-1OC192-XFP | 10 Gbps | 8.0R2 | Duplex LC/PC (Rx and Tx) |

The 10-Gigabit Ethernet cFPC supports the XFPs listed in Table 4 on page 6.

**Table 4: Optical Interface Support for 10-Gigabit Ethernet cFPC**

| Parameter | 10-GBASE-S | 10-GBASE-L | 10-GBASE-E | 10-GBASE-Z |
|---|---|---|---|---|
| Transceiver model number | XFP-10G-S | XFP-10G-L-OC192-SR1 | XFP-10G-E-OC192-IR2 | XFP-10G-Z-OC192-LR2 |
| Optical interface | Multimode | Single-mode | Single-mode | Single-mode |
| Transceiver type | XFP | XFP | XFP | XFP |
| Standard | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | Multivendor agreement |

**Table 4: Optical Interface Support for 10-Gigabit Ethernet cFPC** *(continued)*

| Parameter | 10-GBASE-S | 10-GBASE-L | 10-GBASE-E | 10-GBASE-Z |
|---|---|---|---|---|
| Maximum distance | 50/125 MMF cable, 2000 Mhz-Km: 984 feet/300 m<br><br>50/125 MMF cable, 500 Mhz-Km: 269 feet/82 m<br><br>50/125 MMF cable, 400 Mhz-Km: 217 feet/66 m<br><br>62.5/125 MMF cable, 200 Mhz-Km: 108 feet/33 m<br><br>62.5/125 MMF cable, 160 Mhz-Km: 85 feet/26 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 24.8 miles/40 km: Distances greater than 30 km are considered to be engineered links. | 9/125 SMF cable: 49.6 miles/80 km |
| Transmitter wavelength | 840 through 860 nm | 1260 through 1355 nm | 1530 through 1565 nm | 1530 through 1565 nm |
| Average launch power | –4.5 through –1 dBm | –4 through 0.5 dBm | –4.7 through 4 dBm | 0 through 4 dBm |
| Average receive power | –9.9 through –1.0 dBm | –14.4 through 0.5 dBm | –15.8 through –1.0 dBm | –24.0 through –7.0 dBm |
| Receiver saturation | –1.0 dBm | 0.5 dBm | –1.0 dBm | –7 dBm |
| Receiver sensitivity | –9.9 dBm | –14.4 dBm | –15.8 dBm | –24 dBm |

The SONET/SDH OC192/STM64 cFPC supports the XFPs listed in Table 5 on page 7.

**Table 5: Optical Interface Support for SONET/SDH OC192/STM64 cFPC**

| Parameter | Short reach (SR) 1 | Intermediate reach (IR) 2 | Long Reach (LR) 2 |
|---|---|---|---|
| Transceiver model number | XFP-10G-L-OC192-SR1 | XFP-10G-E-OC192-IR2 | XFP-10G-Z-OC192-LR2. |
| Optical interface | Single-mode | Single-mode | Single-mode |
| Transceiver type | XFP | XFP | XFP |
| Standard | Telcordia GR-253 OC192 SR1 | Telcordia GR-253 OC192 IR2 | Telcordia GR-253 OC192 LR2 |

**Table 5: Optical Interface Support for SONET/SDH OC192/STM64 cFPC** *(continued)*

| Parameter | Short reach (SR) 1 | Intermediate reach (IR) 2 | Long Reach (LR) 2 |
|---|---|---|---|
| Maximum distance | SMF cable:<br>6.21 miles/10 km | SMF cable:<br>24.8 miles/40 km; distances greater than 30 km are considered to be engineered links. | SMF cable:<br>49.71 miles/80 km |
| Transmitter wavelength | 1290 through 1330 nm | 1530 through 1565 nm | 1530 through 1565 nm |
| Average launch power | –6 through –1 dBm | –1.0. through 2 dBm | 0 through 4 dBm |
| Receiver saturation | –1.0 dBm | –1.0 dBm | –7 dBm |
| Receiver sensitivity | –11 dBm | –14 dBm | –24 dBm |

# PIC/FPC Compatibility

Table 6 on page 9 provides a PIC/FPC compatibility matrix for the supported PICs for the M120 router.

**Table 6: M120 PIC/FPC Compatibility**

| PIC Type | Number of Ports | PIC Model Number | FPC1 | FPC2 | FPC3 |
|---|---|---|---|---|---|
| **ATM2 IQ PICs** | | | | | |
| ATM2 DS3 IQ | 4 | PB-4DS3-ATM2 | 8.0R2 | – | – |
| ATM2 E3 IQ | 4 | PB-4E3-ATM2 | 8.0R2 | – | – |
| ATM2 OC3/STM1 IQ | 2 | PB-2OC3-ATM2-MM<br>PB-2OC3-ATM2-SMIR | 8.0R2 | – | – |
| ATM2 OC12/STM4 IQ | 1 | PB-1OC12-ATM2-MM<br>PB-1OC12-ATM2-SMIR | 8.0R2 | – | – |
| ATM2 OC12/STM4 IQ | 2 | PB-2OC12-ATM2-MM<br>PB-2OC12-ATM2-SMIR | – | 8.0R2 | – |
| ATM2 OC48/STM16 IQ, SFP | 1 | PB-1OC48-ATM2-SFP | – | 8.0R2 | – |
| **Channelized IQ PICs** | | | | | |
| ChDS3 IQ | 4 | PB-4CHDS3-QPP | 8.0R2 | – | – |
| ChE1 IQ | 10 | PB-10CHE1-RJ48-QPP | 8.0R2 | – | – |
| ChOC3 IQ | 1 | PB-1CHOC3-SMIR-QPP | 8.0R2 | – | – |
| ChOC12 IQ | 1 | PB-1CHOC12SMIR-QPP | 8.0R2 | – | – |
| ChSTM1 IQ | 1 | PB-1CHSTM1-SMIR-QPP | 8.0R2 | – | – |
| ChT1 IQ | 10 | PB-10CHT1-RJ48-QPP | 8.0R2 | – | – |
| **T1, DS3, E1, E3 PICs** | | | | | |
| DS3 | 4 | PB-4DS3 | 8.0R2 | – | – |
| E1 | 4 | PB-4E1-COAX<br>PB-4E1-RJ48 | 8.0R2 | – | – |
| T1 | 4 | PB-4T1-RJ48 | 8.0R2 | – | – |
| **E3 IQ PIC** | | | | | |
| E3 IQ | 4 | PB-4E3-QPP | 8.0R2 | – | – |

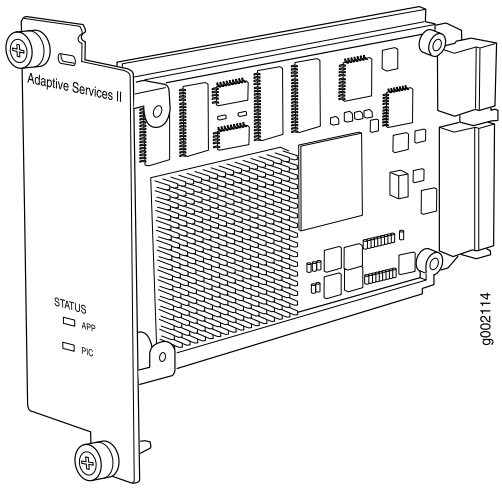
**Table 6: M120 PIC/FPC Compatibility** *(continued)*

| PIC Type | Number of Ports | PIC Model Number | FPC1 | FPC2 | FPC3 |
|---|---|---|---|---|---|
| **EIA-530 PIC** | | | | | |
| EIA-530 | 2 | PB-2EIA530 | 8.0R2 | – | – |
| **Ethernet PICs** | | | | | |
| Fast Ethernet | 4 | PB-4FE-TX | 8.0R2 | – | – |
| Fast Ethernet | 8 | PB-8FE-FX | 8.0R2 | – | – |
| Fast Ethernet | 12 | PB-12FE-TX | 8.0R2 | – | – |
| Fast Ethernet | 48 | PB-48FE-TX | – | 8.0R2 | – |
| Gigabit Ethernet, SFP | 1 | PB-1GE-SFP | 8.0R2 | – | – |
| Gigabit Ethernet, SFP | 2 | PB-2GE-SFP | – | 8.0R2 | – |
| Gigabit Ethernet, SFP | 4 | PB-4GE-SFP | – | 8.0R2 | – |
| Gigabit Ethernet, SFP | 10 | PC-10GE-SFP | – | – | 8.0R2 |
| **10-Gigabit Ethernet PICs** | | | | | |
| 10-Gigabit Ethernet, XENPAK | 1 | PC-1XGE-XENPAK | – | – | 8.0R2 |
| 10-Gigabit Ethernet, DWDM | 1 | PC-1XGE-DWDM-CBAND | – | – | 8.0R2 |
| **Ethernet IQ PICs** | | | | | |
| Gigabit Ethernet IQ, SFP | 1 | PB-1GE-SFP-QPP | 8.0R2 | – | – |
| Gigabit Ethernet IQ, SFP | 2 | PB-2GE-SFP-QPP | – | 8.0R2 | – |
| **10-Gigabit Ethernet IQ2 PICs** | | | | | |
| 10-Gigabit Ethernet IQ2 PIC, XFP | 1 | PC-1XGE-TYPE3–XFP-IQ2 | – | – | 8.2 |
| **Ethernet IQ2 PICs** | | | | | |
| Gigabit Ethernet IQ2, SFP | 4 | PB-4GE-TYPE1-SFP-IQ2 | 8.0R2 | – | – |
| Gigabit Ethernet IQ2, SFP | 8 | PB-8GE-TYPE2-SFP-IQ2 | – | 8.0R2 | – |
| Gigabit Ethernet IQ2, SFP | 8 | PC-8GE-TYPE3-SFP-IQ2 | – | – | 8.5 |
| **Services PICs** | | | | | |
| Adaptive Services II (AS) | 0 | PB-AS2 | 8.0R2 | – | – |
| Adaptive Services II (AS) Layer 2 Services | 0 | PB-AS2-LAYER2SERVICES | 8.0R2 | – | – |
| Adaptive Services II (AS) FIPS | 0 | PB-AS2-FIPS | 8.0R2 | – | – |

**Table 6: M120 PIC/FPC Compatibility** *(continued)*

| PIC Type | Number of Ports | PIC Model Number | FPC1 | FPC2 | FPC3 |
|---|---|---|---|---|---|
| MultiServices 100<br><br>**NOTE:** This PIC requires the 710-017980 version or later of the FPC1. | 0 | PB-MS-100-1 | 8.2R2 | – | – |
| MultiServices 400 | 0 | PB-MS-400-2 | – | 8.2 | – |
| MultiServices 500 | 0 | PC-MS-500-3 | – | – | 8.3 |
| Tunnel Services | 0 | PB-TUNNEL-1 | 8.0R2 | – | – |
| Tunnel Services | 0 | PB-TUNNEL | – | 8.0R2 | – |
| Tunnel Services | 0 | PC-TUNNEL | – | – | 8.0R2 |
| **SONET/SDH PICs** | | | | | |
| OC3c/STM1 | 4 | PB-4OC3-SON-MM<br>PB-4OC3-SON-SMIR | 8.0R2 | – | – |
| OC3/STM1 (Multi-Rate), SFP | 4 | PB-4OC3-10C12-SON-SFP | 8.4 | – | – |
| OC3/STM1 (Multi-Rate), SFP | 4 | PB-4OC3-1OC12-SON2-SFP | – | 8.3 | – |
| OC12c/STM4 | 1 | PB-1OC12-SON-MM<br>PB-1OC12-SON-SMIR | 8.0R2 | – | – |
| OC12/STM4 (Multi-Rate), SFP | 1 | PB-1OC12-SON-SFP | 8.4 | – | – |
| OC12/STM4 (Multi-Rate), SFP | 4 | PB-4OC3-40C12-SON-SFP | – | 8.3 | – |
| OC48c/STM16 | 4 | PC-4OC48-SON-SFP | – | – | 8.0R2 |
| OC48/STM16 (Multi-Rate), SFP | 1 | PB-1OC48-SON-B-SFP | – | 8.3 | – |
| OC192c/STM64, XFP | 1 | PC-1OC192-SON-XFP | – | – | 8.3 |

# Adaptive Services II PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Supports tunnel services. This feature is included with the PIC and does not require an individual license.<br>■ Individual licenses must be purchased for additional services.<br>■ Power requirement: 0.4 A @ 48 V (19 W) |
| **Hardware features** | ■ Support for up to 2000 service sets<br>■ Active monitoring on up to 1 million flows<br>■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces |
| **Software features** | Depending on your JUNOS release and individual licenses, software features for this PIC can include the features listed in Table 7 on page 13. For more information about the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*. |
| **LEDs** | Status LED, one tricolor:<br>■ Off—PIC is offline and it is safe to remove it from the chassis.<br>■ Green—PIC is operating normally.<br>■ Amber—PIC is initializing.<br>■ Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.<br><br>Application LED, one bicolor:<br>■ Off—Service is not running.<br>■ Green—Service is running under acceptable load.<br>■ Amber—Service is overloaded. |

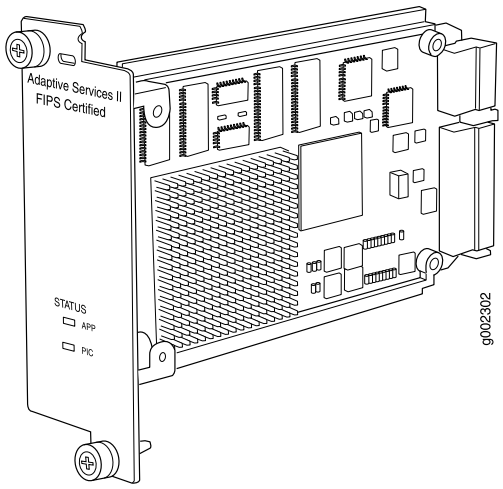
**Table 7: Adaptive Services PICs Software Features Supported by the M120 Router**

| Software Feature | Adaptive Services II PIC | Adaptive Services II Layer 2 Services PIC |
|---|---|---|
| GRE Key | – | – |
| GRE dont-fragment | – | – |
| Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks | 8.0R2 | – |
| Network Address Translation (NAT) for IP addresses | 8.0R2 | – |
| Port Address Translation (PAT) for port numbers | 8.0R2 | – |
| IP Security (IPSec) encryption | 8.0R2 | – |
| Active flow monitoring exports cflowd version 5 and version 8 records | 8.0R2 | – |
| Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954 (IP v4 templates only) | 8.3 | – |
| Passive flow monitoring | – | – |
| Passive flow collection | – | – |
| Flow-tap | – | – |
| Dynamic flow capture | – | – |
| Real-time performance monitoring | 8.3 | – |
| Link services | 8.0R2 | 8.0R2 |
| Tunnel services:<br>■ IP-IP unicast tunneling<br>■ GRE unicast tunneling—Supports GRE fragmentation<br>■ Protocol Independent Multicast (PIM) sparse mode unicast tunneling | 8.0R2 | 8.0R2 |
| Virtual tunnel interface for Layer 3 VPNs | 8.0R2 | – |
| Layer 2 Tunneling Protocol (L2TP) | 8.0R2 | 8.0R2 |
| Voice services:<br>■ Compressed Real-Time Transport Protocol (CRTP) | 8.0R2 | 8.0R2 |

**Table 7: Adaptive Services PICs Software Features Supported by the M120 Router** *(continued)*

| | | |
|---|---|---|
| Encapsulations:<br>■ Multilink Frame Relay (MLFR)<br>■ Multilink Point-to-Point Protocol (MLPP) | 8.0R2 | – |

# Adaptive Services II FIPS PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ JUNOS-FIPS requires an Adaptive Services II FIPS PIC for external IPSec connections. See the *Secure Configuration Guide for Common Criteria and JUNOS-FIPS* for more information.<br>■ Supports tunnel services. This feature is included with the PIC and does not require an individual license.<br>■ Individual licenses must be purchased for additional services such as Network Address Translation (NAT), stateful firewall, intrusion detection services (IDS), IPSec. J-Flow accounting, and voice services. For information about which services are supported by PIC and platform type, see the *JUNOS Services Interfaces Configuration Guide*.<br>■ Power requirement: 0.4 A @ 48 V (19 W) |
| **Hardware features** | ■ Support for up to 2000 service sets<br>■ Active monitoring on up to 1 million flows<br>■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces |

**Software features**

For a list of the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*.

Depending on your JUNOS release and individual licenses, software features for this PIC can include:

- Stateful firewall with packet inspection:
  - Detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks
- NAT for IP addresses
- Port Address Translation (PAT) for port numbers
- J-Flow accounting exports cflowd version 5 and version 8 records
- Tunnel services:
  - IP-IP unicast tunneling
  - GRE unicast tunneling—Supports GRE fragmentation
  - PIM sparse mode unicast tunneling
  - Virtual tunnel interface for Layer 3 VPNs
- IPSec encryption
- Voice services:
  - Compressed Real-Time Protocol (CRTP)
- Encapsulations:
  - Multilink Frame Relay (MLFR)
  - Multilink Point-to-Point Protocol (MLPP)

**LEDs**

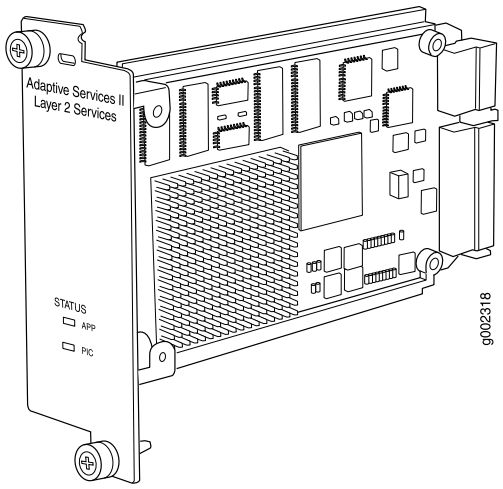
Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the chassis.
- Green—PIC is operating normally.
- Amber—PIC is initializing.
- Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.

Application LED, one tricolor:

- Off—Service is not running.
- Green—Service is running under acceptable load.
- Amber—Service is overloaded.

# Adaptive Services II Layer 2 Services PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Supports Layer 2 Service package only. Tunnel services are included with the PIC. Other services require an individual license.<br>■ Power requirement: 0.4 A @ 48 V (19 W) |
| **Hardware features** | ■ Support for up to 2000 service sets<br>■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces |
| **Software features** | Depending on your JUNOS release and individual licenses, software features for this PIC can include the features listed in Table 8 on page 18. For more information about the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*. |
| **LEDs** | Status LED, one tricolor:<br>■ Off—PIC is offline and it is safe to remove it from the chassis.<br>■ Green—PIC is operating normally.<br>■ Amber—PIC is initializing.<br>■ Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.<br><br>Application LED, one bicolor:<br>■ Off—Service is not running.<br>■ Green—Service is running under acceptable load.<br>■ Amber—Service is overloaded. |

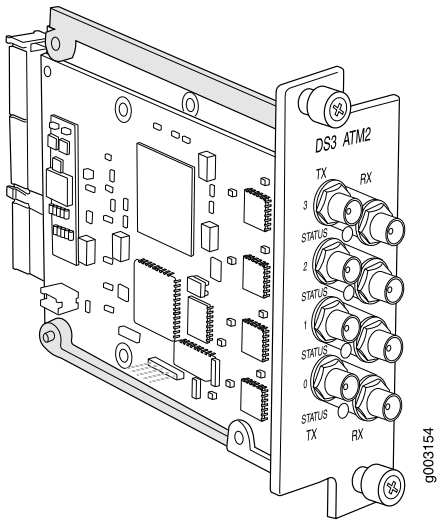
**Table 8: Adaptive Services PICs Software Features**

| Software Feature | Adaptive Services II PIC | Adaptive Services II Layer 2 Services PIC |
|---|---|---|
| GRE Key | – | – |
| GRE dont-fragment | – | – |
| Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks | 8.0R2 | – |
| Network Address Translation (NAT) for IP addresses | 8.0R2 | – |
| Port Address Translation (PAT) for port numbers | 8.0R2 | – |
| IP Security (IPSec) encryption | 8.0R2 | – |
| Active flow monitoring exports cflowd version 5 and version 8 records | 8.0R2 | – |
| Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954 (IP v4 templates only) | 8.3 | – |
| Passive flow monitoring | – | – |
| Passive flow collection | – | – |
| Flow-tap | – | – |
| Dynamic flow capture | – | – |
| Real-time performance monitoring | 8.3 | – |
| Link services | 8.0R2 | 8.0R2 |
| Tunnel services:<br>■ IP-IP unicast tunneling<br>■ GRE unicast tunneling—Supports GRE fragmentation<br>■ Protocol Independent Multicast (PIM) sparse mode unicast tunneling | 8.0R2 | 8.0R2 |
| Virtual tunnel interface for Layer 3 VPNs | 8.0R2 | – |
| Layer 2 Tunneling Protocol (L2TP) | 8.0R2 | 8.0R2 |
| Voice services:<br>■ Compressed Real-Time Transport Protocol (CRTP) | 8.0R2 | 8.0R2 |

**Table 8: Adaptive Services PICs Software Features** *(continued)*

| | | |
|---|---|---|
| Encapsulations:<br>■ Multilink Frame Relay (MLFR)<br>■ Multilink Point-to-Point Protocol (MLPP) | 8.0R2 | – |

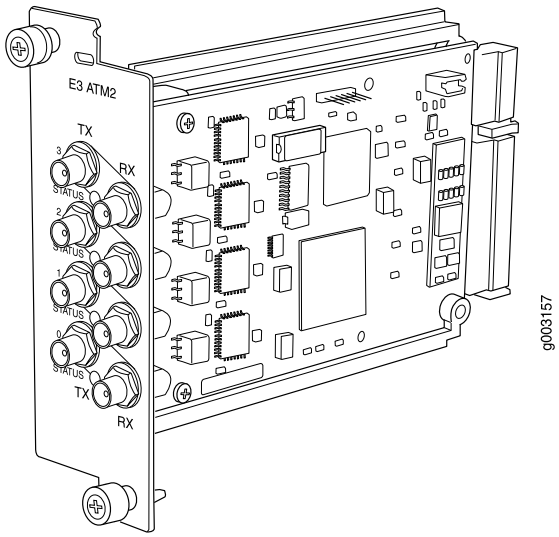
# ATM2 DS3 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four DS3 ports<br>■ Power requirement: 0.41 A @ 48 V (20.0 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface.<br>■ ATM standards compliant |
| **Hardware features** | ■ 16-MB SDRAM memory for ATM segmentation and reassembly (SAR)<br>■ ATM switch ID<br>■ Configurable framing options:<br>  ■ C-bit with ATM direct mapping<br>  ■ C-bit with Physical Layer Convergence Protocol (PLCP) framing (default)<br>  ■ M23 ATM direct mapping<br>  ■ M23 with PLCP framing<br>■ Internal and loop timing |

| | |
|---|---|
| **Software features** | ■ Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping<br>■ Unspecified bit rate (UBR) traffic shaping<br>■ Fine-grained variable bit rate (VBR) traffic shaping<br>■ Circuit cross-connect (CCC)<br>■ ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)<br>■ Simple Network Management Protocol (SNMP):<br>  ■ Management Information Base (MIB) 2 (RFC 1213)<br>  ■ ATM MIB (RFC 1695)<br>  ■ SONET MIB<br>■ AAL5 encapsulations:<br>  ■ ATM-VC-MUX<br>  ■ ATM-NLPID<br>  ■ ATM-Cisco-LLPID<br>  ■ ATM-SNAP<br>  ■ ATM-CCC-VC-MUX |
| **Cables and connectors** | ■ 10 ft (3.05 m) posilock SMB to BNC (provided)<br>■ Four pairs of Rx and Tx coaxial cables |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Far-end block error (FEBE)<br>■ Frame error<br>■ Idle code<br>■ Idle received<br>■ Local and remote loopback<br>■ Loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Path parity error<br>■ Yellow alarm |

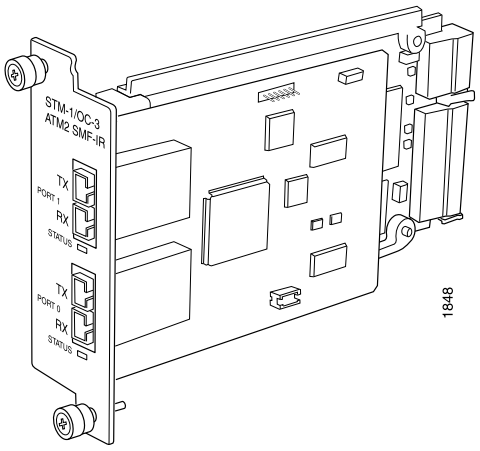
# ATM2 E3 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four E3 ports<br>■ Power requirement: 0.41 A @ 48 V (20 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ ATM standards compliant |
| **Hardware features** | ■ 16-MB SDRAM memory for ATM segmentation and reassembly (SAR)<br>■ ATM switch ID<br>■ Configurable framing options:<br>  ■ G.751 direct mapping<br>  ■ G.751 with PLCP encapsulation (default)<br>  ■ G.832 ATM direct mapping<br>■ Internal and loop timing |

| | |
|---|---|
| **Software features** | ■ Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping<br>■ Unspecified bit rate (UBR) traffic shaping<br>■ Fine-grained variable bit rate (VBR) traffic shaping<br>■ Circuit cross-connect (CCC)<br>■ ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)<br>■ Simple Network Management Protocol (SNMP):<br>  ■ Management Information Base (MIB) 2 (RFC 1213)<br>  ■ ATM MIB (RFC 1695)<br>  ■ SONET MIB<br>■ AAL5 encapsulations:<br>  ■ ATM-VC-MUX<br>  ■ ATM-NLPID<br>  ■ ATM-Cisco-LLPID<br>  ■ ATM-SNAP<br>  ■ ATM-CCC-VC-MUX |
| **Cables and connectors** | ■ 10 ft (3.05 m) posilock SMB to BNC (provided)<br>■ Four pairs of Rx and Tx coaxial cables |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Frame error<br>■ Line code violation<br>■ Local and remote loopback<br>■ Loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Yellow alarm |

# ATM2 OC3/STM1 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Two OC3 ports<br>■ Power requirement: 0.41 A @ 48 V (20 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1<br>■ ATM and SONET/SDH standards compliant<br>■ Alarm and event counting and detection<br>■ Compatible with well-known ATM switches<br>■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches |
| **Hardware features** | ■ Single 3010 SAR for segmentation and reassembly into 53 byte ATM cells<br>■ High-performance parsing of SONET/SDH frames<br>■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing<br>■ 64 MB SDRAM memory for ATM SAR<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ Circuit cross-connect (CCC) for leveraging ATM access networks<br>■ User-configurable virtual circuit (VC) and virtual path (VP) support<br>■ Support for idle cell or unassigned cell transmission<br>■ OAM fault management processes alarm indication signal (AIS), remote defect indicator (RDI) cells, and loop cells<br>■ Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP<br>■ Local and remote loopback<br>■ ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)<br>■ Simple Network Management Protocol (SNMP):<br>  ■ Management Information Base (MIB) 2 (RFC 1213)<br>  ■ ATM MIB (RFC 1695)<br>  ■ SONET MIB<br>■ Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping<br>■ Per-VC or per-VP traffic shaping<br>■ Support for F4 OAM cells<br>■ Support for 16 bit VCI range |
| **Cables and connectors** | ■ Duplex SC/PC connector (RX and TX)<br>■ Optical interface support—See Table 9 on page 25 |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) |

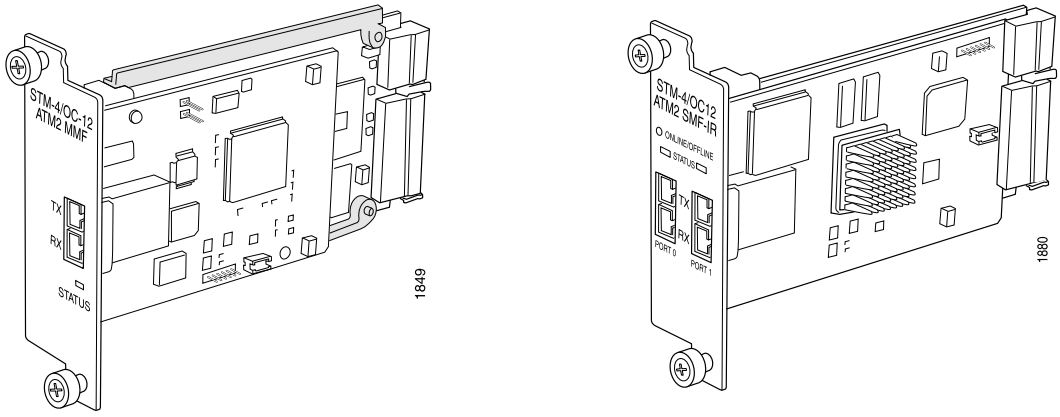
**Table 9: Optical Interface Support for ATM2 OC3 IQ PICs**

| Parameter | Intermediate Reach (IR) | Multimode |
|---|---|---|
| Optical interface | Single-mode | Multimode |
| Transceiver type | Fixed | Fixed |

**Table 9: Optical Interface Support for ATM2 OC3 IQ PICs** *(continued)*

| Parameter | Intermediate Reach (IR) | Multimode |
|---|---|---|
| Standard | Telcordia GR-253 | Multivendor agreement |
| Maximum distance | 9.3 miles/15 km | 1.2 miles/2 km |
| Transmitter wavelength | 1260 through 1360 nm | 1270 through 1380 nm |
| Average launch power | –15 through –8 dBm | –20 through –14 dBm |
| Receiver saturation | –8 dBm | –14 dBm |
| Receiver sensitivity | –28 dBm | –30 dBm |

# ATM2 OC12/STM4 IQ PICs




**Left: 1-port ATM2 OC12/STM4 IQ PIC; Right: 2-port ATM2 OC12/STM4 IQ PIC**

| | |
|---|---|
| **Software release** | ■ 1-port: JUNOS 8.0R2 and later (Type 1)<br>■ 2-port: JUNOS 8.0R2 and later (Type 2)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One or two OC12 ports<br>■ Power requirement:<br>  ■ 1-port: 0.41 A @ 48 V (20 W)<br>  ■ 2-port: 0.52 A @ 48 V (25 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1<br>■ Complies with ATM and SONET/SDH standards<br>■ Alarm and event counting and detection<br>■ Compatible with well-known ATM switches<br>■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches |
| **Hardware features** | ■ ATM2 IQ 1-port OC12 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells; ATM2 IQ 2-port OC12 PICs have dual 3010 SAR<br>■ High-performance parsing of SONET/SDH frames<br>■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing<br>■ 64 MB SDRAM memory for ATM SAR<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ Circuit cross-connect for leveraging ATM access networks<br>■ User-configurable virtual circuit (VC) and virtual path (VP) support<br>■ Support for idle cell or unassigned cell transmission<br>■ OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), and loop cells<br>■ Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP<br>■ Local and remote loopback<br>■ ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC<br>■ Simple Network Management Protocol (SNMP):<br>  ■ Management Information Base (MIB) 2 (RFC 1213)<br>  ■ ATM MIB (RFC 1695)<br>  ■ SONET MIB<br>■ Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping<br>■ Per-VC or per-VP traffic shaping<br>■ Support for F4 OAM cells<br>■ Support for 16-bit VCI range |
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 10 on page 28 |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) |

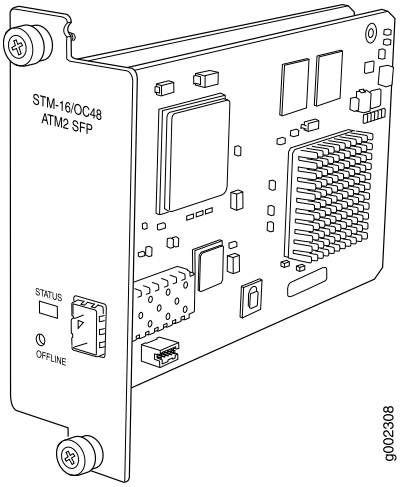
**Table 10: Optical Interface Support for ATM2 OC12/STM4 IQ PICs**

| Parameter | Intermediate Reach (IR) Transceiver | Multimode Transceiver |
|---|---|---|
| Optical interface | Single-mode | Multimode |
| Transceiver type | Fixed | Fixed |

**Table 10: Optical Interface Support for ATM2 OC12/STM4 IQ PICs** *(continued)*

| Parameter | Intermediate Reach (IR) Transceiver | Multimode Transceiver |
|---|---|---|
| Standard | Telcordia GR-253 | Multivendor agreement |
| Maximum distance | 9.3 miles/15 km | 546.8 yards/500 m |
| Transmitter wavelength | 1274 through 1356 nm | 1270 through 1380 nm |
| Average launch power | –15 through –8 dBm | –20 through –14 dBm |
| Receiver saturation | –8 dBm | –14 dBm |
| Receiver sensitivity | –28 dBm | –26 dBm |

# ATM2 OC48/STM16 IQ PIC with SFP




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 2)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One OC48 port<br>■ Power requirement: 0.41 A @ 48 V ( 20 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface.<br>■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1<br>■ Complies with ATM and SONET/SDH standards<br>■ Alarm and event counting and detection<br>■ Compatible with well-known ATM switches<br>■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches<br>■ Optical interface support—see Table 11 on page 31 |
| **Hardware features** | ■ ATM2 IQ 1-port OC48 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells.<br>■ High-performance parsing of SONET/SDH frames<br>■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing<br>■ 64-MB SDRAM memory for ATM SAR<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ Multiprotocol Label Switching (MPLS) circuit cross-connect for leveraging ATM access networks<br>■ User-configurable virtual circuit (VC) and virtual path (VP) support<br>■ Support for idle cell or unassigned cell transmission<br>■ OAM fault management processes alarm indication signal (AIS), remote defect indicator (RDI), and loop cells<br>■ Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP<br>■ Local and remote loopback<br>■ ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC<br>■ Simple Network Management Protocol (SNMP):<br>  ■ Management Information Base (MIB) 2 (RFC 1213)<br>  ■ ATM MIB (RFC 1695)<br>  ■ SONET MIB<br>■ Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping<br>■ Per-VC or per-VP traffic shaping<br>■ Support for F4 OAM cells<br>■ Support for 16-bit VCI range |
| **Cables and connectors** | ■ Duplex LC/PC connector (RX and TX) |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) |

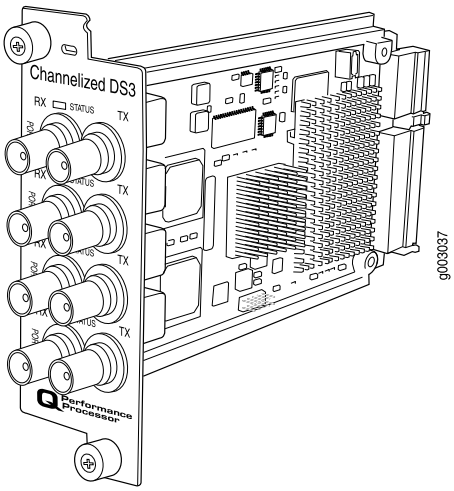
**Table 11: Optical Interface Support for ATM2 IQ OC48 PICs**

| PIC Type | Single-Mode Intermediate Reach |
|---|---|
| Optical interface | Single-mode |
| Transceiver type | SFP |

**Table 11: Optical Interface Support for ATM2 IQ OC48 PICs** *(continued)*

| PIC Type | Single-Mode Intermediate Reach |
|---|---|
| Standard | Telcordia GR-253 |
| Maximum distance | 9.3 miles/15 km |
| Transmitter wavelength | 1274 through 1356 nm |
| Average launch power | –15 through –8 dBm |
| Receiver saturation | –8 dBm |
| Receiver sensitivity | –28 dBm |

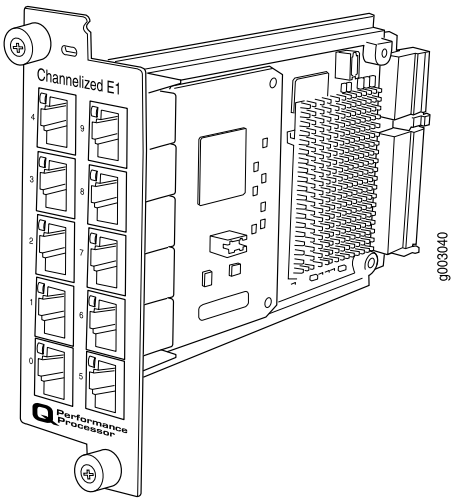
# Channelized DS3 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four DS3 ports<br>■ Power requirement: 0.32 A @ 48 V (15.6 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Channelization: DS3, DS0 |
| **Hardware features** | ■ Data service unit (DSU) functionality<br>■ Subrate and scrambling:<br>  ■ Digital Link/Quick Eagle<br>  ■ Kentrox<br>  ■ Larscom<br>  ■ ADTRAN<br>  ■ Verilink<br>■ B3ZS line encoding<br>■ M13 or C-bit parity<br>■ Full bit error rate test (BERT)<br>■ Local and remote loopback testing |

| | |
|---|---|
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Standard DS3 BNC coaxial cable interfaces |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Excessive zeros (EXZ)<br>■ Far-end block error (FEBE)<br>■ Frame error<br>■ Idle code, Idle received<br>■ Line code violation (LCV)<br>■ Loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Parity bit (P-bit) disagreements<br>■ Path parity error<br>■ Yellow alarm bit (X-bit) disagreements |
| **Instrumentation (counters)** | ■ Layer 2 per-queue and per-channel packet and byte counters |

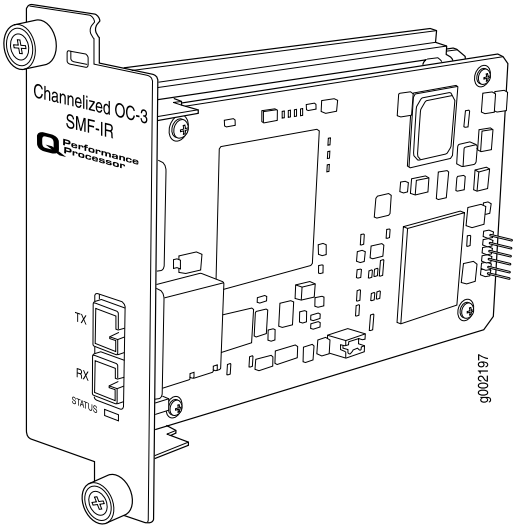
# Channelized E1 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Ten E1 ports<br>■ Power requirement: 0.15 A @ 48 V (7.2 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface.<br>■ Channelization: E1, DS0 |
| **Hardware features** | ■ Data service unit (DSU) functionality<br>■ Ports configurable as clear channel E1 interfaces with 2.048-Mbps connectivity<br>■ Supports unframed E1 G.703 and G.704 framing modes<br>■ Supports HDB3 line coding<br>■ CRC4 configurable<br>■ Local and remote loopback testing |
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Simple Network Management Protocol (SNMP): E1 MIB, DS0 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Full bit error rate test (BERT)<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |

| | |
|---|---|
| **Cables and connectors** | ■ 120-ohm RJ-48C |
| **LEDs** | One bicolor per E1 port:<br>■ Off—Port not enabled<br>■ Green—Physical E1 link is up; individual subchannels can be down<br>■ Red—Physical E1 link is down |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Loss of frame (LOF)<br>■ Out of frame (OOF)<br>■ Failed signal rate (FSR) |
| **Instrumentation (counters)** | ■ Layer 2 per-queue and per-channel packet and byte counters |

# Channelized OC3 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One OC3 port<br>■ Power requirement: 0.39 A @ 48 V (8.6 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface.<br>■ Channelization: DS3, DS1, DS0<br>■ Optical interface support — see Table 12 on page 38 |
| **Hardware features** | ■ Subrate and scrambling:<br>  ■ Digital Link/Quick Eagle<br>  ■ Kentrox<br>  ■ Larscom<br>  ■ Adtran<br>  ■ Verilink<br>■ Packet buffering, Layer 2 parsing<br>■ M13/C-bit parity encoding<br>■ DS3 far-end alarm and control (FEAC) channel support<br>■ Local and remote loopback testing |

| | |
|---|---|
| **Software features** | ■ Quality of Service (QoS) per channel: weighted round-Robin (WRR), random early drop (RED), weighted random early drop (WRED)<br>■ Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Full Bit Error Rate Testing (BERT)<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx); single-mode fiber intermediate-reach fiber |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end Block error (FEBE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Frame error<br>■ Idle code, idle received<br>■ Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Parity bit (P-bit) disagreements<br>■ Path parity error<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), Sseverely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)<br>■ Yellow alarm bit (X-bit) disagreements |

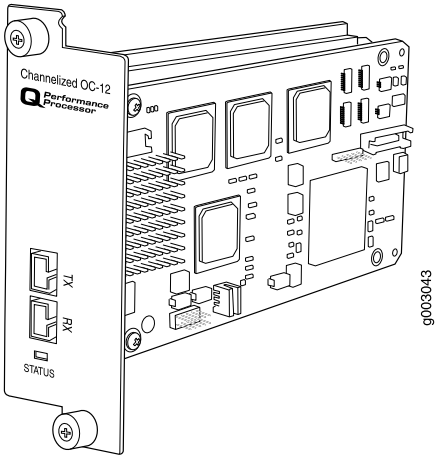
**Table 12: Optical Interface Support for Channelized OC3 IQ PICs**

| PIC Type | Intermediate Reach (IR) |
|---|---|
| Optical interface | Single-mode |
| Standard | Telcordia GR-253 |
| Maximum distance | 9.3 miles/15 km |
| Transmit wavelength | 1274 through 1356 nm |

**Table 12: Optical Interface Support for Channelized OC3 IQ PICs** *(continued)*

| PIC Type | Intermediate Reach (IR) |
|---|---|
| Average launch power | –15 through –8 dBm |
| Receiver saturation | –8 dBm |
| Receiver sensitivity | –28 dBm |

# Channelized OC12 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One OC12 port<br>■ Power requirement: 0.23 A @ 48 V (10.8 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Channelization: OC3, DS3, DS1, DS0 |
| **Hardware features** | ■ Subrate and scrambling:<br>  ■ Digital Link/Quick Eagle<br>  ■ Kentrox<br>  ■ Larscom<br>  ■ ADTRAN<br>  ■ Verilink<br>■ Packet buffering, Layer 2 parsing<br>■ M13/C-bit parity encoding<br>■ DS3 far-end alarm and control (FEAC) channel support<br>■ Local and remote loopback testing |

| | |
|---|---|
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Full bit error rate test (BERT)<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx); single-mode fiber<br>■ Optical interface support—See Table 13 on page 41 |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end block error (FEBE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Frame error<br>■ Idle code, Idle received<br>■ Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Parity bit (P-bit) disagreements<br>■ Path parity error<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)<br>■ Yellow alarm bit (X-bit) disagreements |
| **Instrumentation (counters)** | ■ Layer 2 per-queue and per-channel packet and byte counters |

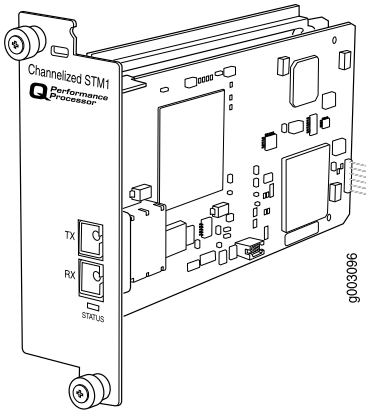
**Table 13: Optical Interface Support for Channelized OC12 IQ PICs**

| Parameter | Intermediate Reach (IR) |
|---|---|
| Optical interface | Single-mode |

**Table 13: Optical Interface Support for Channelized OC12 IQ PICs** *(continued)*

| Parameter | Intermediate Reach (IR) |
|---|---|
| Standard | Telcordia GR-253 |
| Maximum distance | 9.3 miles/15 km |
| Transmitter wavelength | 1274 through 1356 nm |
| Average launch power | –15 through –8 dBm |
| Receiver saturation | –8 dBm |
| Receiver sensitivity | –28 dBm |

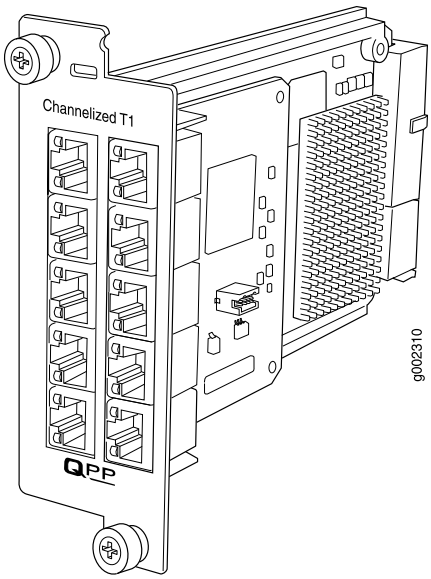
# Channelized STM1 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One STM1 port<br>■ Power requirement: 0.39 A @ 48 V (18.6 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Channelization: STM1c, fractional E1, framed and unframed DS0 |
| **Hardware features** | ■ Packet buffering, Layer 2 parsing<br>■ Local and remote loopback testing |
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ SNMP: SONET/SDH MIB, T1/E1 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Full bit error rate test (BERT) patterns at E1 and DS0 levels<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx); single-mode intermediate-reach fiber |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

| | |
|---|---|
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS-L, AIS-P)<br>■ Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS)<br>■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P)<br>■ Remote defect indication (RDI-L, RDI-P)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) |
| **Instrumentation (counters)** | ■ Layer 2 per-queue and per-channel packet and byte counters |

# Channelized T1 IQ PIC

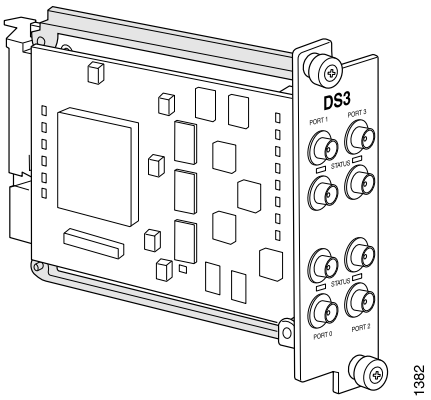



| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Ten T1 ports<br>■ Power requirement: 0.15 A @ 48 V (7.2 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface.<br>■ Channelization: T1, FT1, *N*xDS0 |

| | |
|---|---|
| **Hardware features** | ■ Data service unit (DSU) and channel service unit (CSU) functionality<br>■ Ports configurable as clear channel T1 interfaces with 1.544-Mbps connectivity<br>■ Framing: Superframe (SF or D4) and Extended Superframe (ESF)<br>■ Supports B8ZS (bipolar 8-zero substitution) and AMI (alternate mark inversion) line coding<br>■ Local, remote, and payload loopback testing<br>■ ANSI T1.403 loopback support:<br>  ■ Responds to embedded loopback commands upon receipt of an FDL command from remote end with loopup and loopdown at both line and payload level<br>  ■ Insertion of loopback commands enables remote CSU/NIU/Smartjack to enter loopback and loopdown at both the line and payload level (ANSI and Telcordia)<br>■ Inband loopback support:<br>  ■ Responds to inband loopback commands at both the line and payload level (ANSI and Telcordia)<br>  ■ Insertion of inband loopback commands at both the line and payload level (ANSI and Telcordia)<br>■ Clocking support of external (line) and internal<br>■ Buildout support of the following ranges:<br>  ■ 0 through 132 (Line buildout is from 1 through 132 feet)<br>  ■ 133 through 265 (Line buildout is from 133 through 265 feet)<br>  ■ 266 through 398 (Line buildout is from 266 through 398 feet)<br>  ■ 399 through 531 (Line buildout is from 399 through 531 feet)<br>  ■ 532 through 655 (Line buildout is from 532 through 655 feet) |
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ SNMP: T1 MIB and DS0 MIB<br>■ Dynamic, arbitrary channel configuration<br>■ Full bit error rate test (BERT) patterns at T1 and DS0 levels<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ 120-ohm RJ-48C connector (female) |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

| | |
|---|---|
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Remote defect indication (RDI)<br>■ Loss of frame (LOF)<br>■ Loss of signal (LOS)<br>■ Bipolar violation (BPV)<br>■ Excessive zero (EXZ)<br>■ Line code violation (LCV)<br>■ Error seconds (ES)<br>■ Severely errored seconds (SES)<br>■ Severely errored frames (SEF)<br>■ Bit error event (BEE) |
| **Instrumentation (counters)** | ■ Layer 2 per-queue and per-channel packet and byte counters<br>■ 24–hour history or error counter updated at 15–minute intervals |

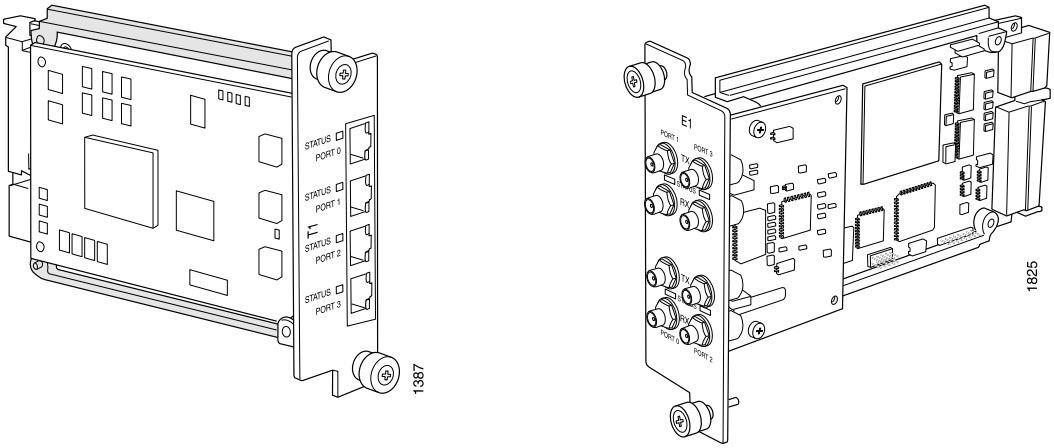
# DS3 PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four DS3 ports<br>■ Power requirement: 0.47 A @ 48 V (22.5 W)<br>■ Integrated DSU interoperability with leading DSU vendors |
| **Hardware features** | ■ High-performance throughput on each port at speeds up to 44.736 Mbps, full duplex<br>■ C-bit framing<br>■ B3ZS line encoding<br>■ Subrate and scrambling:<br>  ■ Digital Link<br>  ■ Kentrox<br>  ■ Larscom<br>■ Per-port rate policing on input<br>■ Per-port rate shaping on output<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ DS3 functionality:<br>  ■ C-bit framing<br>  ■ B3ZS line encoding<br>■ DS3 diagnostics and loopback control<br>■ DS3 alarm and event counting and detection<br>■ Per-packet counts and byte counts<br>■ Local and remote loopback testing, as well as BERT testing per DS3<br>■ DS3 far-end alarm and control (FEAC) channel support<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Custom 10-ft (3.05-m) posilock SMB to BNC male cable, separate Rx and Tx (provided) |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Bit error rate test (BERT) functionality on PIC (you can configure one DS3 channel in BERT mode and configure the remaining channels to transmit and receive normal traffic)<br>■ Equipment failure (does not affect service)<br>■ Far-end block error (FEBE)<br>■ Frame error<br>■ Idle code, Idle received<br>■ Local and remote loopback<br>■ Loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Parity bit (P-bit) disagreements<br>■ Path parity error<br>■ Yellow alarm bit (X-bit) disagreements |

# E1 PICs

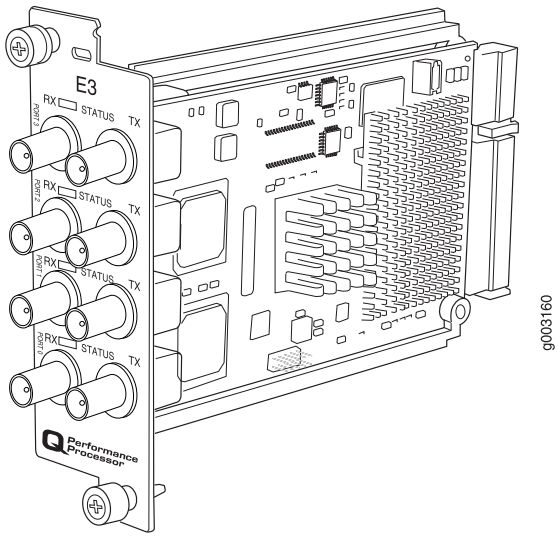



**Left: E1 RJ-48 PIC; Right: E1 Coaxial PIC**

| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four E1 or coaxial ports<br>■ Power requirement: 0.08 A @ 48 V (3.74 W)<br>■ Two versions:<br>  ■ 4-port, 120-ohm, RJ-48<br>  ■ 4-port, 75-ohm, coaxial<br>■ Onboard DSU functionality for E1 connectivity |
| **Hardware features** | ■ High-performance throughput on each port at speeds up to 2.048 Mbps, full duplex<br>■ Maximum transmission units (MTUs) of up to 4500 bytes<br>■ Per-interface diagnostics and loopback control<br>■ Per-interface shaping on output<br>■ Per-interface alarm and event counting and detection<br>■ HDB3 line coding<br>■ 4-bit CRC for G.704 framed mode<br>■ Per-port loop timing<br>■ Balanced and unbalanced modes<br>■ Packet buffering, Layer 2 parsing<br>■ Full bit error rate test (BERT) |

| | |
|---|---|
| **Software features** | ■ Integrated support for G.703 unframed mode and G.704 framed mode with CRC; this feature is user-configurable<br><br>**NOTE:** The G.704 implementation supports speeds slower than 2.048 Mbps; multiple channels within a single E1 interface are not supported.<br><br>■ Configurable clock source: Internal or loop<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Two versions:<br>  ■ Four RJ-48 connectors (one per port)<br>  ■ Four coaxial connectors<br>■ Custom 10-ft (3.05-m) posilock to BNC male cable, separate Rx and Tx |
| **LEDs** | One tricolor per port:<br><br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Bipolar violations<br>■ Excessive zeros<br>■ Far-end block errors (FEBE, E-bit errors)<br>■ Loss of frame (LOF), Loss of signal (LOS)<br>■ Local and remote loopback diagnostics<br>■ Yellow alarm bit (X-bit) disagreements |

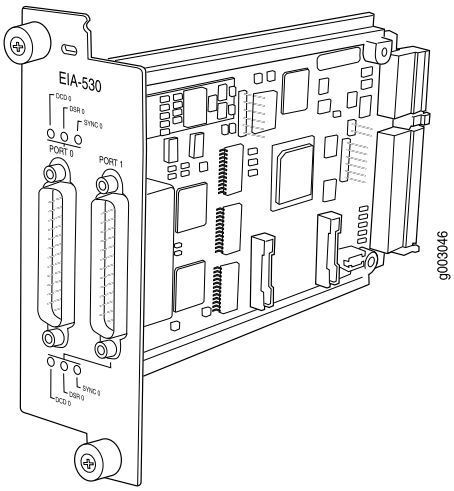
# E3 IQ PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four E3 ports<br>■ Power requirement: 0.38 A @ 48 V (18 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface |
| **Hardware features** | ■ Clear-channel (34.368-Mbps) and subrate E3<br>■ Unframed or ITU G.751 framing<br>■ Data service unit (DSU) functionality<br>■ Subrate and scrambling:<br>  ■ Digital Link/Quick Eagle<br>  ■ Kentrox<br>■ HDB3 line encoding<br>■ Full bit error rate test (BERT)<br>■ Local and remote loopback testing |

| | |
|---|---|
| **Software features** | ■ Quality of service (QoS) per port: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Simple Network Management Protocol (SNMP): E3 MIB, QoS MIB<br>■ Input policing and output shaping<br>■ Provider-side rate limiting<br>■ Full data link connection identifier (DLCI) range with sparse channel numbering<br>■ Per-DLCI queues with weighted deficit round-robin and strict priority<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP)<br>■ JUNOS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES). |
| **Cables and connectors** | ■ Standard E3 BNC coaxial cable interfaces |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Equipment failure (does not affect service)<br>■ Frame error<br>■ Line code violation<br>■ Loss of signal (LOS)<br>■ Out of frame (OOF)<br>■ Yellow alarm bit (A-bit) disagreements |
| **Instrumentation (counters)** | ■ Layer 2 per-queue packet and byte counters |

# EIA-530 PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Two EIA-530, X.21 or V.35 serial ports<br>■ Power requirement: 0.07 A @ 48 V (3.4 W) |
| **Hardware features** | ■ Configured as data terminal equipment (DTE) ports<br>■ Resynchronization signal<br>■ Receives clock rates up to 16 Mbps<br>■ Local, data communications equipment (DCE) local, and DTE remote loopbacks |

**Software features**

- Supports four queues per port
- Random early detection (RED)
- Transmitter Signal Element Timing is looped from the timing received on the Transmitted Signal Element DCE. EIA-530 ports support the ability to invert the Transmit Data Element. The EIA-530 ports support the following rates:
  - 2.048 Mbps
  - 2.341 Mbps
  - 2.731 Mbps
  - 3.277 Mbps
  - 4.09 Mbps
  - 5.461 Mbps
  - 8.192 Mbps
  - 16.384 Mbps
- V.35 ports support up to 2.048 Mbps
- X.21 ports support up to 10 Mbps
- Encapsulations:
  - High-Level Data Link Control (HDLC)
  - Frame Relay
  - Circuit cross-connect (CCC)
  - Translational cross-connect (TCC)
  - Point-to-Point Protocol (PPP)

**Cables and connectors**

- Two DB-25 male connectors (one per port, included with PIC)
- V.35 requires an EIA-530 to V.35 cable and connects to a V.35 DTE 34-pin Winchester type male cable (one per port)
- X.21 requires an EIA-530 to X.21 cable and connects to a X.21 DTE DB-15 male cable

**LEDs**

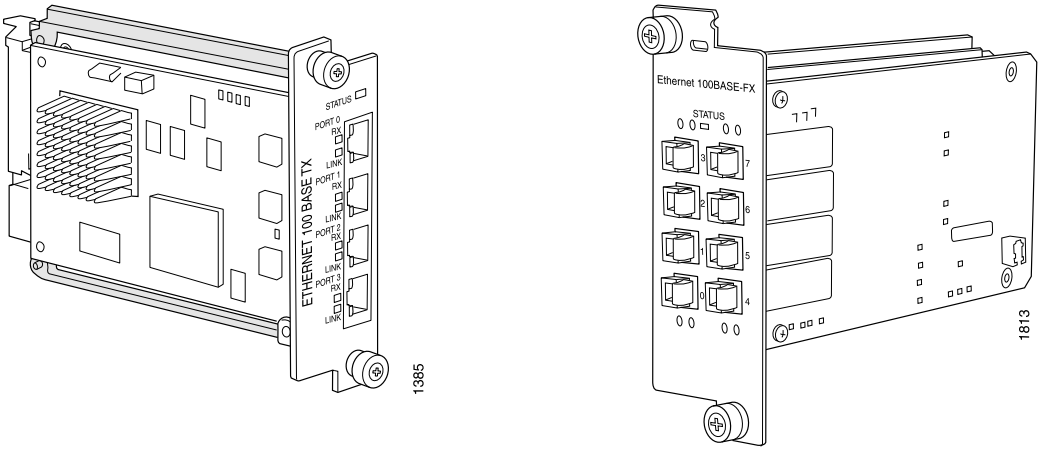
Three bicolor per port:

- Data set ready (DSR):
  - Green—DSR is detected or ignored
  - Red—DSR expected but not present
- Data carrier detect (DCD):
  - Green—DCD is detected or ignored
  - Red—DCD expected but not present
- Resynchronization:
  - Green—Keepalives are being received
  - Red—Data terminal ready (DTR) toggled from low to high (resynchronization pulses are being sent)

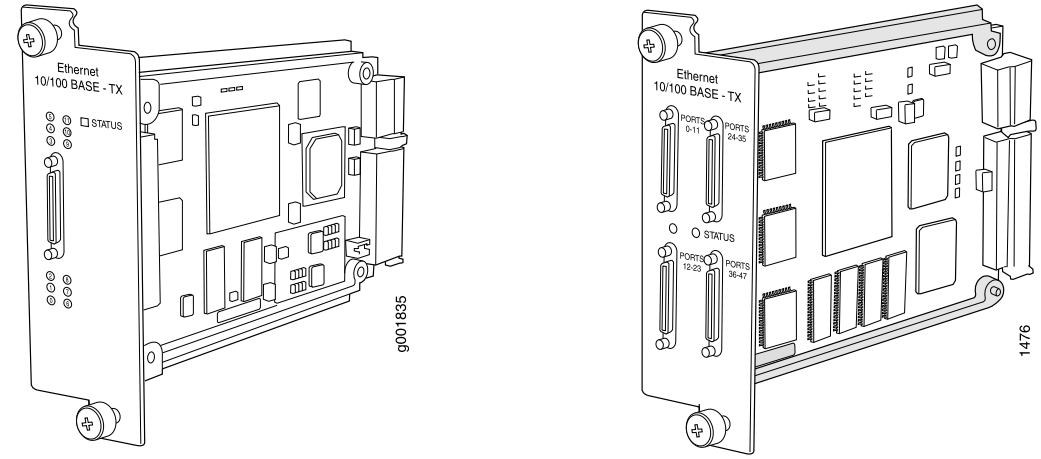
**Instrumentation (counters)**

- Per-port packet and byte counters
- Resynchronization counters:
  - Number of resynchronizations initiated
  - Time of last resynchronization

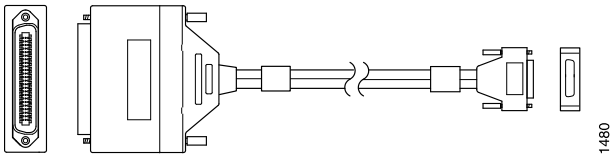
# Fast Ethernet PICs




**Left: 4-Port Fast Ethernet PIC; Right: 8-Port Fast Ethernet PIC**




**Left: 12-Port Fast Ethernet PIC; Right: 48-Port Fast Ethernet PIC**




**VHDCI to RJ-21 Cable**

| | |
|---|---|
| **Software release** | ■ 4-port: JUNOS 8.0R2 and later (Type 1)<br>■ 8-port: JUNOS 8.0R2 and later (Type 1)<br>■ 12-port: JUNOS 8.0R2 and later (Type 1)<br>■ 48-port: JUNOS 8.0R2 and later (Type 2)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ 4 100Base-TX ports<br>■ 8 100Base-FX ports<br>■ 12 100Base-TX ports<br>■ 48 100Base-TX ports<br>■ Power requirement:<br>  ■ 4-port: 0.14 A @ 48 V (6.8 W)<br>  ■ 8-port: 0.26 A @ 48 V (12.5 W)<br>  ■ 12-port: 0.23 A @ 48 V (11 W)<br>  ■ 48-port: 0.69 A @ 48 V (33.3 W) |
| **Hardware features** | ■ High-performance throughput on each port at speeds up to 100 Mbps<br>■ Source and destination Media Access Control (MAC) address filtering<br>■ RMON EtherStats packet buffering<br>■ 802.3 Ethernet standard compliant<br>■ 4-port PICs support MTUs of up to 9,192 bytes; 8-port, 12-port, and 48-port PICs support MTUs of up to 1,532 bytes<br>■ 4-port PICs support 1,024 802.1Q VLANs per port; 8-port, 12-port, and 48-port PICs support 16 802.1Q VLANs per port |
| **Software features** | ■ Autosensing full-duplex and half-duplex modes<br>■ Virtual Router Redundancy Protocol (VRRP)<br>■ 802.1q virtual LANs (VLANs)<br>■ Circuit cross-connect (CCC) VLAN |

**Cables and connectors**

4-port PIC:

- Connector: Two-pair, Category 5 unshielded twisted-pair connectivity through an RJ-45 connector
- Pinout: MDI noncrossover

8-port PIC:

- Connector: MT-RJ female
- FX optical interface—see Table 14 on page 59

12-port PIC:

- Connector: One very High Density Connector Interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel

48-port PIC:

- VHDCI to RJ-21 cables that connect to an RJ-45 patch panel
- Four VHDCI connectors that each service 12 10/100 ports

**NOTE:** Each of the four connectors on a Fast Ethernet 48-port PIC can support a maximum of approximately 800 Mbps. However, this constitutes oversubscription. Use this PIC only in environments that can support this level of oversubscription.

**LEDs**

Status LED, one bicolor:

- Off—PIC ports not enabled
- Green—PIC is operating normally
- Red—PIC has an error or failure

4-port PIC—One pair of port LEDs:

- Link LED—If green, the port is online; if there is no light, the port is down
- RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data

8-port PIC—one pair of port LEDs per port:

- Port link LED—If green, the port is online; if there is no light, the port is down

**NOTE:** The Link LED remains lit on the 8-port PIC when the port is down.

- Port RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data

12-port PIC—one port LED per port:

- Green—100-Mbps link established
- Flashing green—100-Mbps activity
- Yellow—10-Mbps link established
- Flashing yellow—10-Mbps activity
- Off—No link present

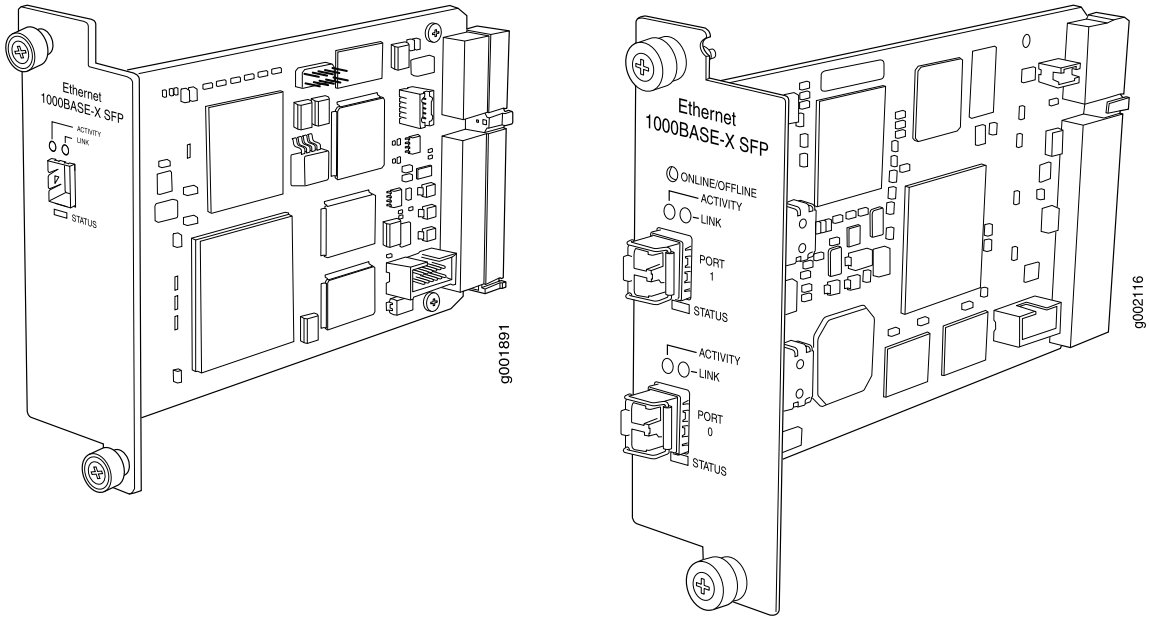
**NOTE:** The port LEDs remains lit on the 12-port PIC when the ports are down.

48-port PIC—does not have port LEDs. To check port status on a 48-port PIC, use the **show interfaces fe-*fpc/pic/port*** command. For more information about this command, see the *JUNOS Network Interfaces Configuration Guide*.

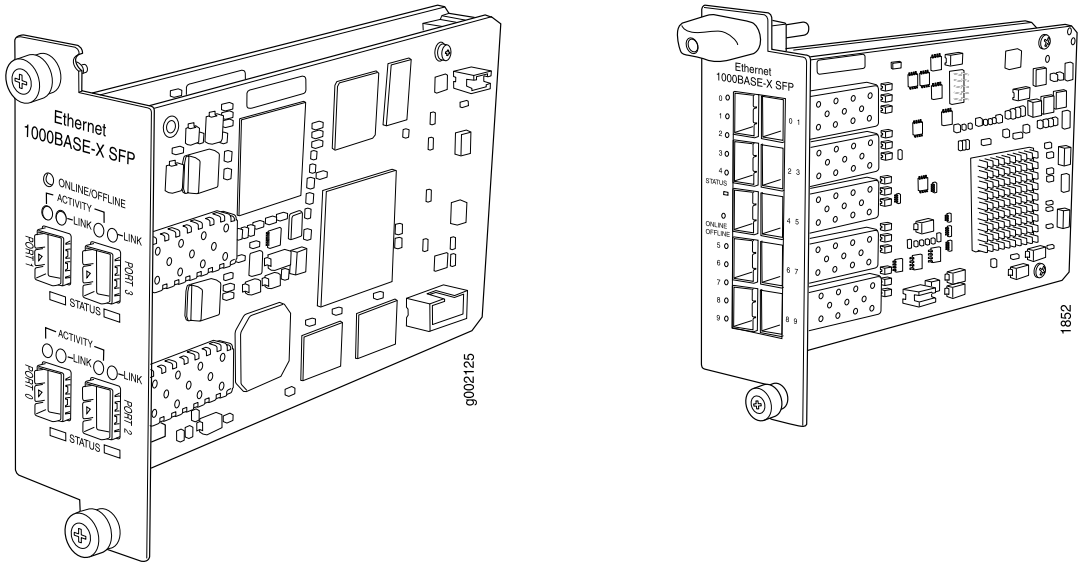
**Table 14: Optical Interface Support for Fast Ethernet PICs**

| Parameter | FX Interface for 8-Port |
|---|---|
| Optical interface | Multimode |
| Maximum distance | 62.5/125 MMF cable: 1.24 miles /2 km |
| Wavelength | 1,270 to 1,380 nm |
| Average launch power | –20 to –14 dBm |
| Receiver saturation | –14 dBm |
| Receiver sensitivity | –34 dBm |

# Gigabit Ethernet PICs with SFP




**Left: 1-Port Gigabit Ethernet PIC; Right: 2-Port Gigabit Ethernet PIC**




**Left: 4-Port Gigabit Ethernet PIC; Right: 10-Port Gigabit Ethernet PIC**

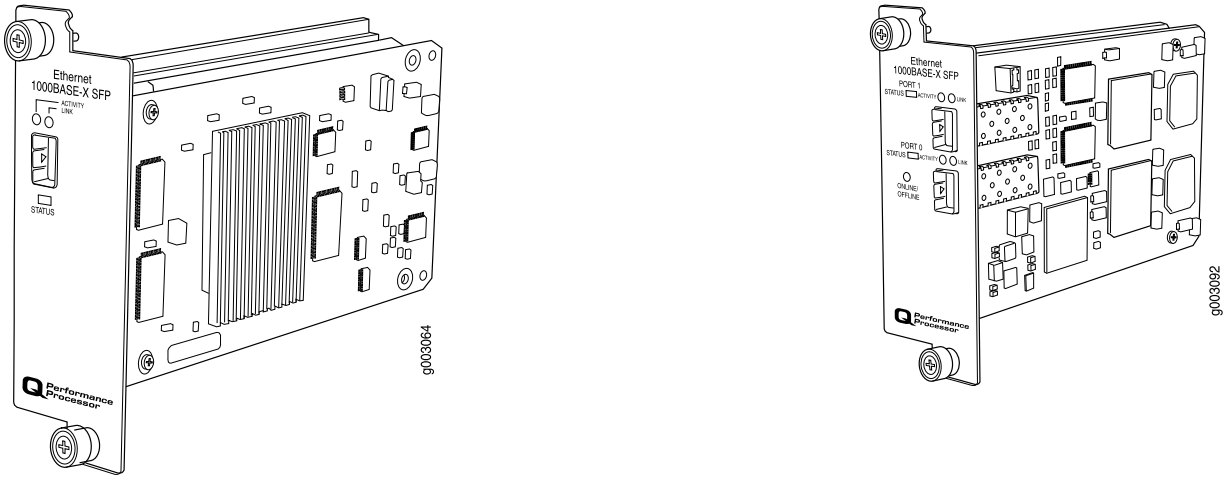
| | |
|---|---|
| **Software release** | ■ 1-port: JUNOS 8.0R2 and later (Type 1)<br>■ 2-port: JUNOS 8.0R2 and later (Type 2)<br>■ 4-port: JUNOS 8.0R2 and later (Type 2)<br>■ 10-port: JUNOS 8.0R2 and later (Type 3)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One, two, four, or ten Gigabit Ethernet ports<br>■ Power requirement:<br>  ■ 1-port: 0.15 A @ 48 V (7.3 W)<br>  ■ 2-port: 0.25 A @ 48 V (11.9 W)<br>  ■ 4-port: 0.50 A @ 48 V (23.8 W)<br>  ■ 10-port: 0.62 A @ 48 V (29.9 W)<br>■ Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network |
| **Hardware features** | ■ High-performance throughput on each port at speeds up to 1 Gbps<br>■ Autonegotiation between Gigabit Ethernet circuit partners<br>■ Full-duplex mode<br>■ Maximum transmission units (MTUs) of up to 9192 bytes |
| **Software features** | ■ Virtual Router Redundancy Protocol (VRRP) support<br>■ 802.1q virtual LANs (VLANs) support<br>■ 960 destination MAC filters per port<br>■ Optical diagnostics and related alarms on the 2-port, 4-port, and 10-port PICs (JUNOS 8.2 and later)<br>■ Flexible Ethernet encapsulation on the 1-port, 2-port, and 4-port PICs<br>■ Multiple tag protocol identifiers (TPID) support on the 1-port, 2-port, and 4-port PICs<br>■ Source MAC learning on the 1-port, 2-port, and 4-port PICs<br>■ MAC accounting and policing—Dynamic local address learning of source MAC addresses on the 1-port, 2-port, and 4-port PICs<br><br>**NOTE:** The 10-port Gigabit Ethernet PIC with SFP does not support MAC accounting and policing, MAC learning, TPID, or flexible Ethernet encapsulation. |
| **Cables and connectors** | ■ You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Fiber-optic SFP transceivers:<br>  ■ Duplex LC/PC connector (Rx and Tx)<br>  ■ Optical interface support—See Table 15 on page 62<br>■ 1000Base-T SFP transceivers:<br>  ■ Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector<br>  ■ Pinout: MDI crossover<br>  ■ Length: 328 ft/100 m<br><br>**NOTE:** Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP. |

| | |
|---|---|
| **LEDs** | Status LED, one bicolor:<br>■ Off—PIC is not enabled<br>■ Green—PIC is operating normally<br>■ Red—PIC has an error or failure<br><br>Port LEDs, one pair per port:<br>■ Link—If green, the port is online; if there is no light, the port is down<br>■ Activity—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data |

**Table 15: Optical Interface Support for Gigabit Ethernet PICs with SFP**

| Parameter | 1000Base-SX | 1000Base-LX | 1000Base-LH |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | 62.5/125 MMF cable: 656 ft/200 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 43.5 miles/70 km |
| | 50/125 MMF cable: 1640 ft/500 m | 62.5/125 and 50/125 MMF cable: 1804.5 ft/550 m | |
| Transmitter wavelength | 770 through 860 nm | 1270 through 1355 nm | 1355 through 1580 nm |
| Average launch power | –9.5 through 0 dBm | –11.5 through –3 dBm | –3 through +3 dBm |
| Average receive power | –17 through 0 dBm | –19 through –3 dBm | –20 through –3 dBm |
| Receiver saturation | 0 dBm | –3 dBm | –3 dBm |
| Receiver sensitivity | –17 dBm | –19 dBm | –20 dBm |

# Gigabit Ethernet IQ PICs with SFP




**Left: 1-port Gigabit Ethernet IQ PIC; Right: 2-port Gigabit Ethernet IQ PIC**

| | |
|---|---|
| **Software release** | ■ 1-port: JUNOS 8.0R2 and later (Type 1)<br>■ 2-port: JUNOS 8.0R2 and later (Type 2)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One or two Gigabit Ethernet ports<br>■ Power requirement: 0.46 A @ 48 V (22 W)<br>■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface<br>■ Optical interface support—See Table 16 on page 64 |
| **Hardware features** | ■ High-performance throughput on each port at speeds up to 1 Gbps<br>■ Full-duplex mode<br>■ Large MTUs of up to 9192 bytes |
| **Software features** | ■ Optical diagnostics and related alarms<br>■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Virtual Router Redundancy Protocol (VRRP) support<br>■ 802.1q virtual LANs (VLANs)<br>■ VLAN stacking and rewriting<br>■ Flexible Ethernet encapsulation<br>■ MAC policing, accounts, and filters<br>■ JUNOS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES). |

**Cables and connectors**

- You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.
- Fiber-optic SFP transceivers:
  - Duplex LC/PC connector (Rx and Tx)
  - Optical interface support—see Table 16 on page 64
- 1000Base-T SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - Pinout: MDI crossover
  - Length: 328 ft/100 m

**NOTE:** Do not install SONET/SDH OC48c/STM16 SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.

**LEDs**

Status LED, one tricolor:

- Off—Not enabled
- Green—Online with no alarms or failures
- Amber—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

**NOTE:** The green status LED is lit on the 2-port Gigabit Ethernet IQ PIC when at least one port is online.

Port LEDs, one per port:

- Off—Port is down
- Green—Link is established

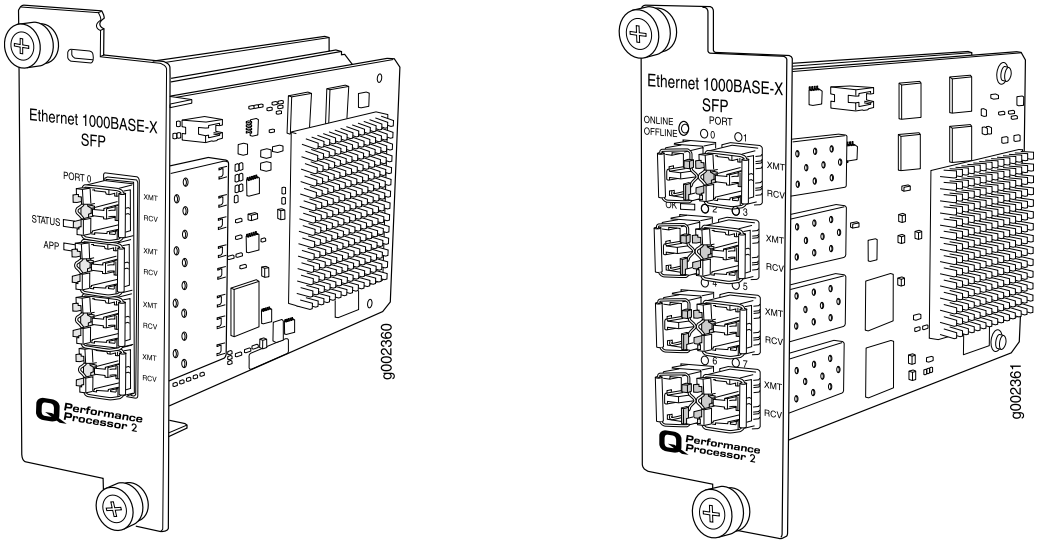
**Table 16: Optical Interface Support for Gigabit Ethernet IQ PICs with SFP**

| Parameter | 1000Base-SX | 1000Base-LX | 1000Base-LH |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Standard | IEEE 802.3—1998 | IEEE 802.3—1998 | Multivendor agreement |
| Maximum distance | 62.5/125 MMF cable: 656 ft/200 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 43.5 miles/70 km |
| | 50/125 MMF cable: 1640 ft/500 m | 62.5/125 or 50/125 MMF cable: 1804.5 ft/550 m | |
| Transmitter wavelength | 770 through 860 nm | 1270 through 1355 nm | 1480 through 1580 nm |
| Average launch power | –9.5 through 0 dBm | –11.5 through –3 dBm | –3 through +3 dBm |

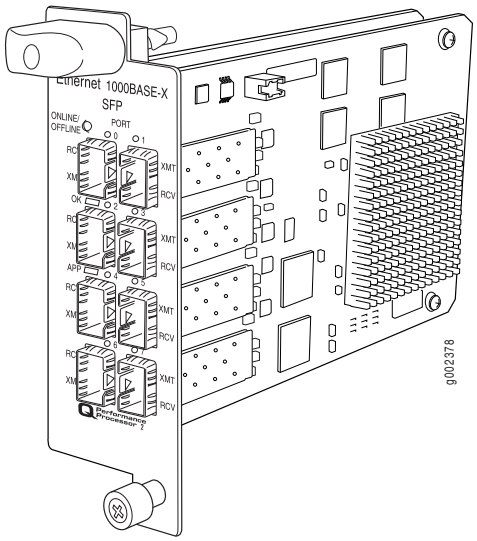
**Table 16: Optical Interface Support for Gigabit Ethernet IQ PICs with SFP** *(continued)*

| Parameter | 1000Base-SX | 1000Base-LX | 1000Base-LH |
|---|---|---|---|
| Average receive power | –17 through 0 dBm | –19 through –3 dBm | –20 through –3 dBm |
| Receiver saturation | 0 dBm | –3 dBm | –3 dBm |
| Receiver sensitivity | –17dBm | –19 dBm | –20 dBm |

# Gigabit Ethernet IQ2 PICs with SFP




**Left: 4-port Gigabit Ethernet IQ2 PIC (Type 1); Right: 8-port Gigabit Ethernet IQ2 PIC (Type 2)**




**Center: 8-port Gigabit Ethernet IQ2 PIC (Type 3)**

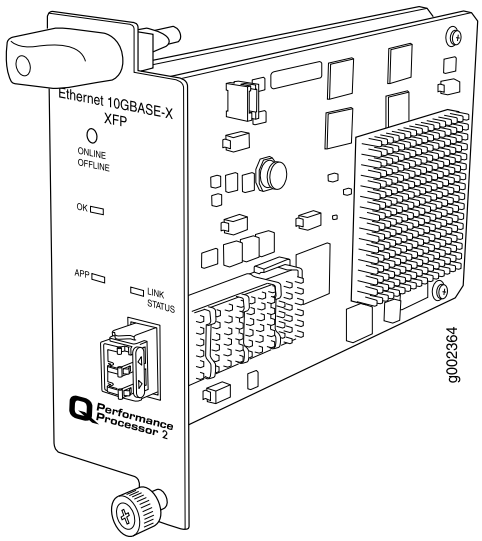
| | |
|---|---|
| **Software release** | ■ 4-port: JUNOS 8.0R2 and later (Type 1)<br>■ 8-port: JUNOS 8.0R2 and later (Type 2)<br>■ 8-port: JUNOS 8.5 and later (Type 3)<br><br>**NOTE:** These PICs are not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four or eight Gigabit Ethernet ports<br>■ Power requirement:<br>  ■ 4-port: 0.65 A @ 48 V (31W)<br>  ■ 8-port (Type 2): 0.89 A @ 48 V (42.5W)<br>  ■ 8-port (Type 3): 1.25 A @48 V (60 W) |
| **Hardware features** | ■ High-performance throughput on each port:<br>  ■ 4-port with SFP: speeds up to 1 Gbps<br>  ■ 8-port with SFP: speeds up to 4 Gbps<br>■ Full-duplex mode<br>■ Large maximum transmission units (MTUs) of up to 9192 bytes |

| | |
|---|---|
| **Software features** | ■ Intelligent handling of oversubscribed traffic for Type 1 and Type 2 PICs<br>■ Optical diagnostics and related alarms<br>■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Virtual Router Redundancy Protocol (VRRP) support<br>■ Hierarchical shaping<br>■ Fine-grained queuing and shaping per logical interface at both ingress and egress<br>■ 802.1q virtual LANs (VLANs)<br>■ VLAN stacking and rewriting<br>■ Channels defined by two stacked VLAN tags<br>■ Point-to-Point Protocol over Ethernet (PPPoE) over VLAN (JUNOS Release 8.5 and later.)<br>■ Multiple tag protocol identifiers (TPID) support<br>■ IP service for nonstandard TPID and stacked VLAN tags<br>■ 802.1p rewrite per channel<br>■ Flexible mapping of channels and scheduler resources at both ingress and egress<br>■ Flexible Ethernet encapsulation<br>■ MAC learning, policing, accounting, and filtering |
| **Cables and connectors** | ■ You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br><br>**NOTE:** Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.<br><br>■ Fiber-optic small form-factor pluggable transceivers (SFPs):<br>  ■ Duplex LC/PC connector (Rx and Tx)<br>  ■ Optical interface support—See Table 17 on page 69<br>■ Copper 1000Base-T SFPs:<br>  ■ Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector<br>  ■ Pinout: MDI crossover<br>  ■ Length: 328 ft/100 m |
| **LEDs** | OK or Status LED, one tricolor:<br>■ Off—PIC is offline and it is safe to remove it from the router.<br>■ Green—PIC is operating normally.<br>■ Amber—PIC is initializing.<br>■ Red—PIC has an error or failure.<br><br>APP LED, one bicolor:<br>■ Off—Monitoring application is not running.<br>■ Green—Monitoring application is running under acceptable load.<br><br>Port LEDs, one per port:<br>■ Off—Port is not enabled.<br>■ Green—Port is online with no alarms or failures. |

**Table 17: Optical Interface Support for Gigabit Ethernet IQ2 PICs with SFP**

| Parameter | 1000Base-SX | 1000Base-LX | 1000Base-LH |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Standard | IEEE 802.3—1998 | IEEE 802.3—1998 | Multivendor agreement |
| Maximum distance | 62.5/125 MMF cable: 656 ft/200 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 43.5 miles/70 km |
| | 50/125 MMF cable: 1640 ft/500 m | 62.5/125 or 50/125 MMF cable: 1804.5 ft/550 m | |
| Transmitter wavelength | 770 through 860 nm | 1270 through 1355 nm | 1480 through 1580 nm |
| Average launch power | –9.5 through 0 dBm | –11.5 through –3 dBm | –3 through +3 dBm |
| Average receive power | –17 through 0 dBm | –19 through –3 dBm | –20 through –3 dBm |
| Receiver saturation | 0 dBm | –3 dBm | –3 dBm |
| Receiver sensitivity | –17dBm | –19 dBm | –20 dBm |

# 10-Gigabit Ethernet IQ2 PIC with XFP



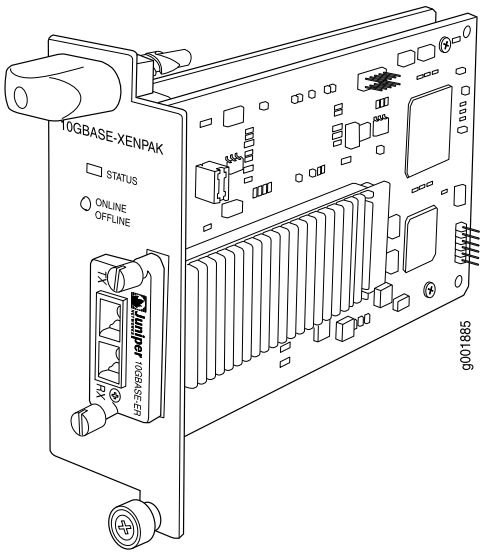

| | |
|---|---|
| **Software release** | ■ JUNOS 8.2 and later (Type 3) |
| **Description** | ■ One 10-Gigabit Ethernet port<br>■ Power requirements: 1.2 A @48 V (56 W) |
| **Hardware features** | ■ High-performance throughput<br>■ WAN-PHY mode at 9.953 Gbps<br>■ LAN-PHY mode at 10.3125 Gbps<br>■ Full-duplex mode<br>■ Large maximum transmission units (MTUs) of up to 9192 bytes |

| | |
|---|---|
| **Software features** | ■ Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)<br>■ Configurable WAN-PHY mode options:<br>  ■ loopback<br>  ■ mpls<br>  ■ path-trace<br>  ■ trigger<br>■ Virtual Router Redundancy Protocol (VRRP) support<br>■ Hierarchical shaping<br>■ Fine-grained queueing and shaping per logical interface at both ingress and egress<br>■ 802.1q virtual LANs (VLANs)<br>■ Point-to-Point Protocol over Ethernet (PPPoE) over VLAN (JUNOS Release 8.5 and later.)<br>■ VLAN stacking and rewriting<br>■ Channels defined by two stacked VLAN tags<br>■ Multiple tag protocol identifiers (TPID) support<br>■ IP service for nonstandard TPID and stacked VLAN tags<br>■ 802.1p rewrite per channel<br>■ Flexible mapping of channels and scheduler resources at both ingress and egress<br>■ Flexible Ethernet encapsulation<br>■ MAC learning, policing, accounting, and filtering |
| **Cables and connectors** | ■ You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:<br>  ■ Duplex LC/PC connector (Rx and Tx)<br>  ■ Optical interface support—See Table 18 on page 72 |
| **LEDs** | OK LED, one tricolor:<br>■ Off—PIC is offline and safe to remove from the router.<br>■ Green—PIC is operating normally.<br>■ Amber—PIC is initializing.<br>■ Red—PIC has an error or failure.<br><br>APP LED, one:<br>■ Off—Monitoring application is not running<br>■ Green—Monitoring application is running under acceptable load<br>■ Amber—Monitoring application is overloaded<br><br>Link Status LED, one:<br>■ Off—Port is down<br>■ Green—Port is online. Link is established |

**Table 18: Optical Interface for 10-Gigabit Ethernet IQ2 PICs**

| Parameter | 10-GBase-S | 10-GBase-L | 10-GBase-E | 10-GBase-Z |
|---|---|---|---|---|
| Transceiver model number | XFP-10G-S | XFP-10G-L-OC192-SR1 | XFP-10G-E-OC192-IR2 | XFP-10G-Z-OC192-LR2 |
| Optical interface | Multimode | Single-mode | Single-mode | Single-mode |
| Transceiver type | XFP | XFP | XFP | XFP |
| Standard | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | Multivendor agreement |
| Maximum distance | 50/125 MMF cable, 2000 MHz-km: 984 feet/300 m<br><br>50/125 MMF cable, 500 MHz-km: 269 feet/82 m<br><br>50/125 MMF cable, 400 MHz-km: 217 feet/66 m<br><br>62.5/125 MMF cable, 200 MHz-km: 108 feet/33 m<br><br>62.5/125 MMF cable, 160 MHz-km: 85 feet/26 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 24.8 miles/40 km: Distances greater than 30 km are considered to be engineered links. | 9/125 SMF cable: 49.6 miles/80 km |
| Transmitter wavelength | 840 nm through 860 nm | 1260 through 1355 nm | 1530 through 1565 nm | 1530 through 1565 nm |
| Average launch power | –4.5 through –1 dBm | –8.2 through 0.5 dBm | –4.7 through 4 dBm | 0 through 4 dBm |
| Average receive power | –9.9 through –1.0 dBm | –14.4 through 0.5 dBm | –15.8 through –1.0 dBm | –24.0 through –7.0 dBm |
| Receiver saturation | –1.0 dBm | 0.5 dBm | –1.0 dBm | –7 dBm |
| Receiver sensitivity | –9.9 dBm | –14.4 dBm | –15.8 dBm | –24 dBm |

# 10-Gigabit Ethernet PIC with XENPAK




| | |
|---|---|
| **Software release** | ■ 10-Gigabit Ethernet PIC with XENPAK: JUNOS 8.0R2 and later (Type 3)<br>■ XENPAK-OTN transceivers: JUNOS 9.0R2 and later<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One 10-Gigabit Ethernet port<br>■ Power requirement: 0.55 A @ 48 V (26.6 W)<br>■ Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network<br>■ Optical interface support—See Table 19 on page 74 and Table 20 on page 75 |
| **Hardware features** | ■ High-performance throughput at speeds up to 10 Gbps<br>■ Full-duplex mode<br>■ Maximum transmission units (MTUs) up to 9192 bytes<br>■ 64 source MAC address filters<br>■ 960 destination MAC filters |
| **Software features** | ■ Virtual Router Redundancy Protocol (VRRP) support<br>■ 802.1q virtual LANs (VLANs) support<br>■ 802.3ae link aggregation support<br>■ RMON EtherStats<br>■ Optical diagnostics and related alarms :<br>  ■ Transceiver temperature<br>  ■ Laser bias current<br>  ■ Laser output power<br>  ■ Receive optical power |

| | |
|---|---|
| **Cables and connectors** | ■ Duplex SC/PC connector (RX and TX)<br>■ Optical interface support—See Table 19 on page 74 and Table 20 on page 75 |
| **LEDs** | Status LED, one bicolor:<br>■ Off—PIC not enabled<br>■ Green—PIC is operating normally<br>■ Red—PIC has an error or failure<br><br>Port LEDs, one pair:<br>■ Link—If green, the port is online; if there is no light, the port is down<br>■ RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data |

**Table 19: Optical Interface Support for 10-Gigabit Ethernet PICs with XENPAK**

| Parameter | Short Wavelength Serial (10GBase-SR), LAN Rate | Long Wavelength Serial (10GBase-LR), LAN Rate | Extra-Long Wavelength Serial (10GBase-ER), LAN Rate | Extra-Long Wavelength Serial (10GBase-ZR), LAN Rate |
|---|---|---|---|---|
| Transceiver model number | XENPAK-1XGE-SR | XENPAK-1XGE-LR | XENPAK-1XGE-ER | XENPAK-1XGE-ZR |
| Optical interface | Multimode | Single-mode | Single-mode | Single-mode |
| Transceiver type | XENPAK module | XENPAK module | XENPAK module | XENPAK module |
| Standard | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | IEEE 802.3ae—2002 | Multivendor agreement |
| Maximum distance | 50/125 MMF cable, 2000 MHz-km: 984 feet/300 m<br><br>50/125 MMF cable, 500 MHz-km: 269 feet/82 m<br><br>50/125 MMF cable, 400 MHz-km: 217 feet/66 m<br><br>62.5/125 MMF cable, 200 MHz-km: 108 feet/33 m<br><br>62.5/125 MMF cable, 160 MHz-km: 85 feet/26 m | 9/125 SMF cable: 6.2 miles/10 km | 9/125 SMF cable: 24.8 miles/40 km: Distances greater than 30 km are considered to be engineered links. | 9/125 SMF cable: 49.6 miles/80 km |
| Transmitter wavelength | 840 nm through 860 nm | 1260 through 1355 nm | 1530 through 1565 nm | 1530 through 1565 nm |
| Average launch power | –4.5 through –1 dBm | –4 through 0.5 dBm | –4.7 through 4 dBm | 0 through 4 dBm |

**Table 19: Optical Interface Support for 10-Gigabit Ethernet PICs with XENPAK** *(continued)*

| Parameter | Short Wavelength Serial (10GBase-SR), LAN Rate | Long Wavelength Serial (10GBase-LR), LAN Rate | Extra-Long Wavelength Serial (10GBase-ER), LAN Rate | Extra-Long Wavelength Serial (10GBase-ZR), LAN Rate |
|---|---|---|---|---|
| Average receive power | –9.9 through –1.0 dBm | –14.4 through 0.5 dBm | –15.8 through –1.0 dBm | –24.0 through –7.0 dBm |
| Receiver saturation | –1.0 dBm | 0.5 dBm | –1.0 dBm | –7 dBm |
| Receiver sensitivity | –9.9 dBm | –14.4 dBm | –15.8 dBm | –24 dBm |

These tables describe the 10-Gigabit Ethernet XENPAK-OTN transceivers: Table 20 on page 75, Table 21 on page 76, and Table 22 on page 77.

**Table 20: Optical Interface Support for 10-Gigabit Ethernet PICs with XENPAK-OTNs**

| | |
|---|---|
| **Model numbers** | ■ XENPAK-1XGE-32A-OTN<br>■ XENPAK-1XGE-34A-OTN<br>■ XENPAK-1XGE-36A-OTN<br>■ XENPAK-1XGE-38A-OTN<br>■ XENPAK-1XGE-40A-OTN<br>■ XENPAK-1XGE-42A-OTN |
| **Features** | ■ 10-Gigabit digital wrapper with over-clocked G.709 framing<br>■ Generic Reed-Solomon forward error correction (GFEC) to transport 10GBASE-R (10-Gigabit Ethernet LAN)<br>■ Reduced cost of deploying and maintaining the network due to:<br>  ■ Fewer optical-electrical-optical (OEO) conversions<br>  ■ Fewer optical amplifiers and regenerators<br>■ Two tunable wavelengths (channels) supported per XENPAK-OTN module<br>■ Link fault switchover<br>■ PC-1XGE-XENPAK-PIC feature support |
| **Transceiver type** | ■ XENPAK module |
| **Standards** | ■ ITU-T G.709—Interfaces for the Optical Transport Network (OTN)<br>■ ITU-T G.873.1—Optical Transport Network (OTN): Linear Protection<br>■ RFC 3591—Definitions of Managed Objects for the Optical Interface Type |
| **Line interface** | ■ Line rate: 11.09 Gbps<br>■ Line rate deviation: ±20 ppm (G.709 LAN PHY with stuffing)<br>■ Dispersion window: –600 to +1200 ps/nm or –700 to +1500 ps/nm (maximum)<br>■ FEC type: Generic Reed-Solomon RS (255, 239) code computed as specified in Annex A/G. 709 |

**Table 20: Optical Interface Support for 10-Gigabit Ethernet PICs with XENPAK-OTNs** *(continued)*

| | |
|---|---|
| **Optical transmitter** | ■ Transmitter type: Electro-absorption Modulated Laser (EML)<br>■ Modulation format: Non-retum-to-zero (NRZ)<br>■ Channel-plan wavelength range: 1551.72 through 1542.94 nm<br>■ Channel-plan frequency range: 193.2 through 194.3 THz<br>■ Channel spacing: 100 GHz<br>■ Channel tunability: 2 channels<br>■ Output power (on): 0 to + 3 dBm<br>■ Output power (off): ≤ – 40 dBm<br>■ Output power stability: ± 0.6 dB<br>■ Wavelength accuracy: ± 100 pm<br>■ Tuning time: Warm tune – 10 seconds; Cold start – 40 seconds<br>■ Extinction ratio: ≥ 9 dB<br>■ Side-mode suppression ratio: ≥ 30 dB<br>■ Jitter generation compliance: GR-253/G.8251 |
| **Optical receiver** | ■ Receiver type: Avalanche photodiode (APD)<br>■ Jitter tolerance compliance: GR-53/G.8251/802.3ae (LAN PHY)<br>■ Rx DTV setting: Auto<br>■ Rx wavelength range: 1527 to 1567 nm<br>■ Overload: – 5 dBm<br>■ Damage input power: + 5 dBm<br>■ Optical return loss: ≥ 27 dB |
| **Optical performance** | Optical Applications—Power-Limited Receiver:<br>■ Sensitivity: – 28 dBm (> 33dB/0.1 nm OSNR, 0 ps/nm CD, $10^{-15}$ post-FEC BER)<br>■ Chromatic dispersion (CD) power penalty: 3 dB (typical penalty at + 1600 ps/nm and – 700 ps/nm CD)<br><br>Optical Applications—Noise-Limited Receiver:<br>■ Required OSNR: 16 dB/0.1 nm ( – 8 to – 20 dBm Rx input power, 0 ps/nm CD, $10^{-15}$ post-FEC BER)<br>■ CD OSNR penalty: 4 dB (typical penalty at + 1500 ps/nm and – 700 ps/nm CD with Rx input power from – 8 to – 20 dBm). For more detailed information, see Table 21 on page 76. |

**Table 21: XENPAK-OTN Optical Signal-to-Noise Ratio (OSNR) Performance**

| OSNR (dB/0.1 nm) | OSNR (dB/0.5 nm) | FEC Type | Pre-FEC BER | Post-FEC BER | Input-Power Range (dBm) | CD Tolerance (ps/nm) |
|---|---|---|---|---|---|---|
| 33 | 26 | GFEC | $10^{-5}$ | $10^{-15}$ | –5 to –28 | 0 |
| 33 | 26 | GFEC | $10^{-5}$ | $10^{-15}$ | –5 to –26 | –700 to + 1600 |
| 16 | 9 | GFEC | $10^{-5}$ | $10^{-15}$ | –8 to –20 | 0 |

**Table 21: XENPAK-OTN Optical Signal-to-Noise Ratio (OSNR) Performance** *(continued)*

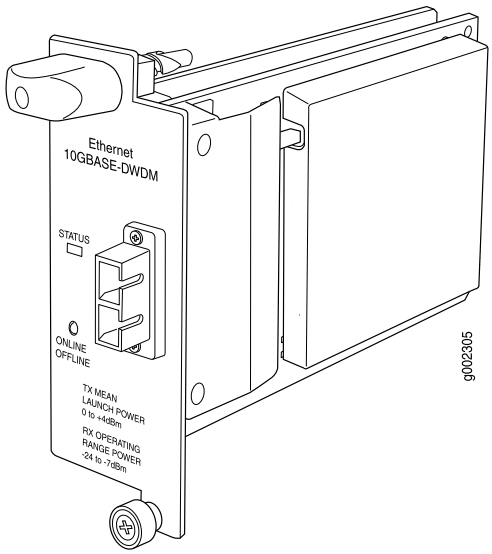
| OSNR (dB/0.1 nm) | OSNR (dB/0.5 nm) | FEC Type | Pre-FEC BER | Post-FEC BER | Input-Power Range (dBm) | CD Tolerance (ps/nm) |
|---|---|---|---|---|---|---|
| 17 | 10 | GFEC | $10^{-5}$ | $10^{-15}$ | –8 to –20 | –400 to +800 |
| 18 | 11 | GFEC | $10^{-5}$ | $10^{-15}$ | –8 to –20 | –600 to +1200 |
| 20 | 13 | GFEC | $10^{-5}$ | $10^{-15}$ | –8 to –20 | –700 to +1500 |

In Table 22 on page 77, one Juniper index number corresponds to the factory-set frequency that corresponds to the XENPAK-OTN model number. For example, Juniper index number 32 corresponds to the factory-set frequency 193.2 THz, which corresponds to model number XENPAK-1XGE-32A-OTN. The other Juniper index number corresponds to the alternate frequency. For example, Juniper index number 33 corresponds to the alternate frequency 193.3 THz.

**Table 22: XENPAK-OTN Factory-Set/Alternate Frequency/Wavelength Reference**

| Factory-Set Wavelength (nm) | Factory-Set Frequency (THz) | Juniper Index Number (corresponds to factory-set frequency) | Alternate Wavelength (nm) | Alternate Frequency (THz) | Juniper Index Number (corresponds to alternate frequency) | Model Number (“A” denotes two wavelengths) |
|---|---|---|---|---|---|---|
| 1551.72 | 193.2 | 32 | 1550.92 | 193.3 | 33 | XENPAK-1XGE-32A-OTN |
| 1550.12 | 193.4 | 34 | 1549.32 | 193.5 | 35 | XENPAK-1XGE-34A-OTN |
| 1548.51 | 193.6 | 36 | 1547.72 | 193.7 | 37 | XENPAK-1XGE-36A-OTN |
| 1546.92 | 193.8 | 38 | 1546.12 | 193.9 | 39 | XENPAK-1XGE-38A-OTN |
| 1545.32 | 194.0 | 40 | 1544.53 | 194.1 | 41 | XENPAK-1XGE-40A-OTN |
| 1543.73 | 194.2 | 42 | 1542.94 | 194.3 | 43 | XENPAK-1XGE-42A-OTN |

# 10-Gigabit Ethernet DWDM PIC



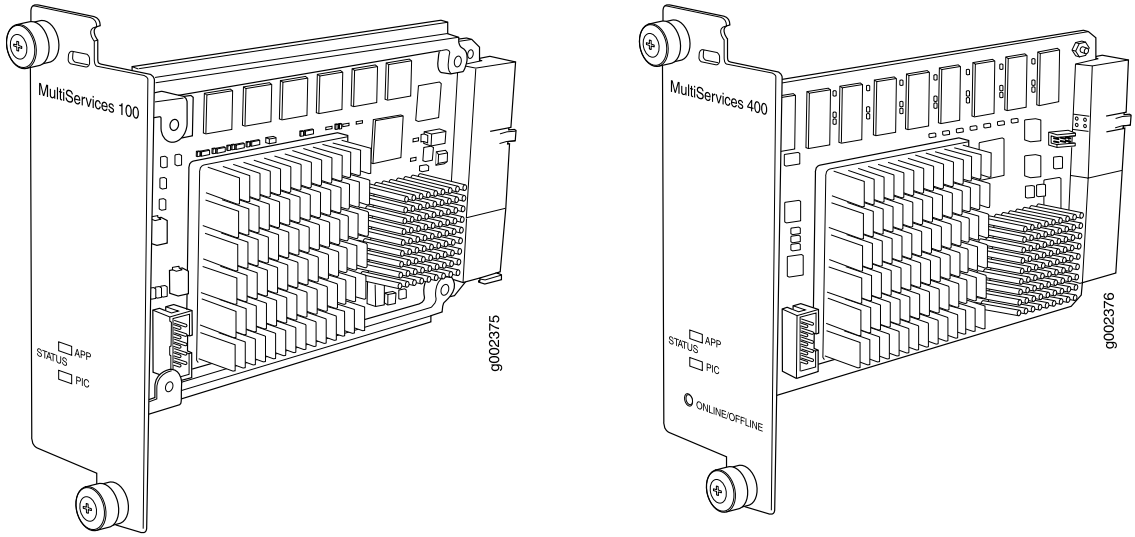

| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 3)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One 10-Gigabit Ethernet port<br>■ Power requirement: 0.55 A @ 48 V (26.6 W)<br>■ Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network |
| **Hardware features** | ■ C-band ITU-Grid with 100 GHz spacing<br>■ High-performance throughput at speeds up to 10 Gbps<br>■ Full-duplex mode<br>■ Maximum transmission units (MTUs) up to 9192 bytes<br>■ 64 source MAC address filters<br>■ 960 destination MAC filters<br>■ 45 individual wavelengths: 1528.77 nm, 1529.55 nm, 1530.33 nm, 1531.12 nm, 1531.90 nm, 1532.68 nm, 1533.47 nm, 1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1537.40 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, 1540.56 nm, 1541.35 nm, 1542.14 nm, 1542.94 nm, 1543.73 nm, 1544.53 nm, 1545.32 nm, 1546.12 nm, 1546.92 nm, 1547.72 nm, 1548.52 nm, 1549.32 nm, 1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1553.33 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, 1556.56 nm, 1557.36 nm, 1558.17 nm, 1558.98 nm, 1559.79 nm, 1560.61 nm, 1561.42 nm, 1562.23 nm, 1563.05 nm, 1563.86 nm |

| | |
|---|---|
| **Software features** | ■ Enhanced optical monitoring capabilities<br>■ CLI configurable wavelength support<br>■ Virtual Router Redundancy Protocol (VRRP) support<br>■ 802.1q virtual LANs (VLANs) support<br>■ 802.3ae link aggregation support<br>■ RMON EtherStats |
| **Cables and connectors** | ■ Duplex SC/PC connector (RX and TX) |
| **LEDs** | Status LED, one bicolor:<br>■ Off—PIC is not enabled<br>■ Green—PIC is operating normally<br>■ Red—PIC has an error or failure<br><br>Port LEDs, one pair:<br>■ Link—If green, the port is online; if there is no light, the port is down<br>■ RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data |

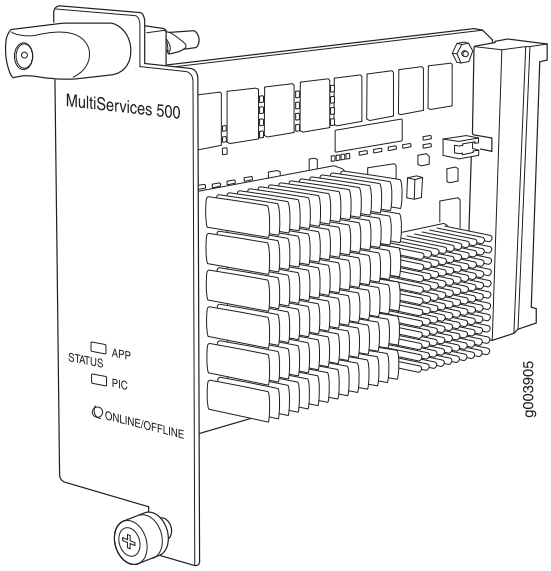
**Table 23: Optical Interface Support for 10-Gigabit Ethernet DWDM PICs**

| Parameter | Extra-Long Wavelength Serial DWDM, LAN Rate |
|---|---|
| Optical interface | Single-mode |
| Transceiver type | Dense wavelength division multiplexing (DWDM) |
| Standard | ITU-T G.694.1 |
| Maximum distance | 9/125 SMF cable: 49.6 miles/80 km |
| Transmitter wavelength | 1528.77 through 1563.86 nm, 100-GHz ITU grid |
| Average launch power | 0 through 4 dBm |
| Transmit extinction ratio | 9 dBm |
| Average receive power | –7 dBm through –24 dBm |
| Receiver saturation | –7 dBm |
| Receiver sensitivity | –24 dBm |

# MultiServices PICs




**Left: MultiServices 100 PIC; Right: MultiServices 400 PIC**




**Center: MultiServices 500 PIC**

| Software release |
|---|

- MultiServices 100: JUNOS 8.2R2 and later (Type 1)

**NOTE:** This PIC requires the 710-017980 version of the FPC1.

- MultiServices 400: JUNOS 8.2 and later (Type 2)
- MultiServices 500: JUNOS 8.3 and later (Type 3)

| | |
|---|---|
| **Description** | ■ Supports tunnel services. This feature is included with the PIC and does not require an individual license.<br>■ Individual licenses must be purchased for additional services.<br>■ Power requirement:<br>  ■ Type 1: 0.52 A @ 48 V (25 W)<br>  ■ Type 2: 0.69 A @ 48 V (33 W)<br>  ■ Type 3: 0.83 A @ 48 V (40 W) |
| **Hardware features** | ■ Active monitoring on:<br>  ■ Type 1: up to 1.6 million flows<br>  ■ Type 2: up to 3.2 million flows<br>  ■ Type 3: up to 3.2 million flows |
| **Software features** | ■ Support for up to 2000 service sets<br>■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces<br><br>Depending on your JUNOS release and individual licenses, software features for this PIC can include the features listed in Table 24 on page 81. For more information about the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*. |
| **LEDs** | Status LED, one tricolor:<br>■ Off—PIC is offline and it is safe to remove it from the chassis.<br>■ Green—PIC is operating normally.<br>■ Amber—PIC is initializing.<br>■ Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.<br><br>Application LED, one bicolor:<br>■ Off—Service is not running.<br>■ Green—Service is running under acceptable load.<br>■ Amber—Service is overloaded. |

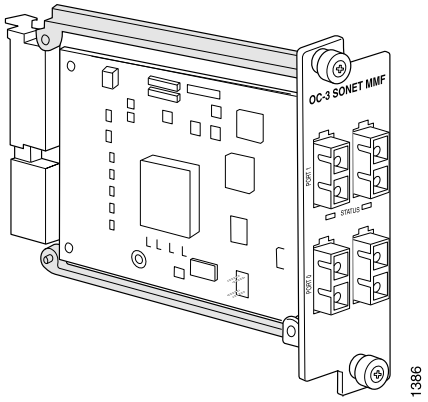
**Table 24: MultiServices PICs Software Features Supported on the M120 Router**

| Software Feature | MultiServices 100 | MultiServices 400 | MultiServices 500 |
|---|---|---|---|
| GRE Key | – | – | – |
| GRE dont-fragment | – | – | – |

**Table 24: MultiServices PICs Software Features Supported on the M120 Router** *(continued)*

| | | | |
|---|---|---|---|
| Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks | 8.2R2 | 8.2 | 8.3 |
| Network Address Translation (NAT) for IP addresses | 8.2R2 | 8.2 | 8.3 |
| Port Address Translation (PAT) for port numbers | 8.2R2 | 8.2 | 8.3 |
| IP Security (IPSec) encryption | 8.2R2 | 8.2 | 8.5 |
| Active flow monitoring exports cflowd version 5 and version 8 records | 8.2R2 | 8.2 | 8.3 |
| Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954 | 8.3 | 8.3 | 8.5 |
| Passive flow monitoring | – | 8.4 | – |
| Passive flow collection | – | 8.5 | – |
| Flow-tap | 8.2R2 | 8.2 | 8.5 |
| Dynamic flow capture | – | 8.4 | – |
| Real-time Performance Monitoring | 8.2R2 | 8.2 | 8.5 |
| Link services | 8.2R2 | 8.2 | 8.5 |
| Tunnel services:<br>■ IP-IP unicast tunneling<br>■ GRE unicast tunneling—Supports GRE fragmentation<br>■ Protocol Independent Multicast (PIM) sparse mode unicast tunneling | 8.2R2 | 8.2 | 8.3 |
| Virtual tunnel interface for Layer 3 VPNs | 8.2R2 | 8.2 | 8.3 |
| Layer 2 Tunneling Protocol (L2TP) | 8.2R2 | 8.2 | 8.3 |
| Voice services:<br>■ Compressed Real-Time Transport Protocol (CRTP) | 8.2R2 | 8.2 | 8.5 |
| Encapsulations:<br>■ Multilink Frame Relay (MLFR)<br>■ Multilink Point-to-Point Protocol (MLPP) | 8.2R2 | 8.2 | 8.3 |

# SONET/SDH OC3c/STM1 PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** Although the illustration shows a multimode PIC, a multimode PIC and a single-mode intermediate reach PIC are both supported.<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four OC3 ports<br>■ Power requirement: 0.49 A @ 48 V (23.7 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |
| **Software features** | ■ SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |

| | |
|---|---|
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 25 on page 85<br><br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

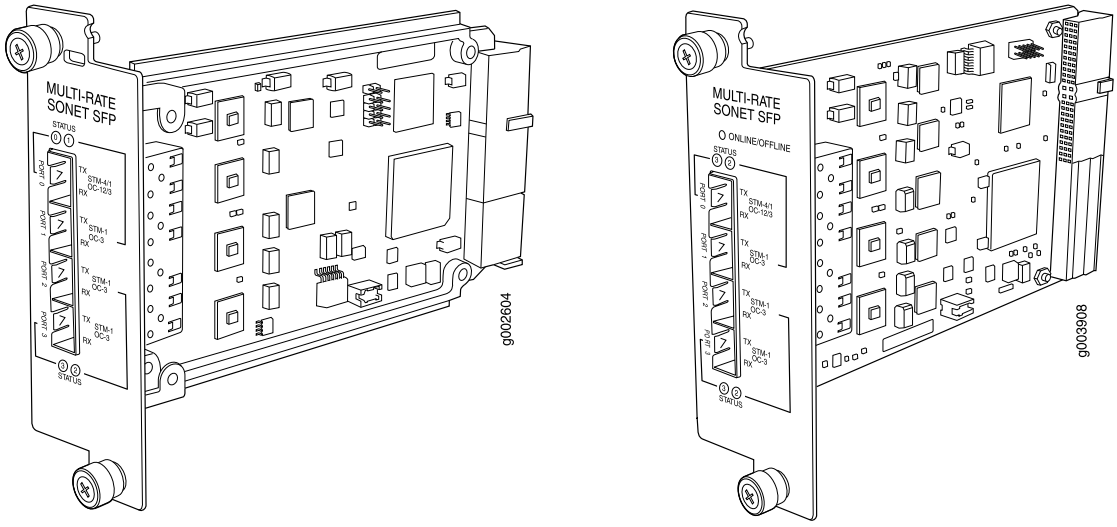
**Table 25: Optical Interface Support for SONET/SDH OC3c/STM1 PICs**

| Parameter | Intermediate Reach | Multimode |
|---|---|---|
| Optical interface | Single-mode | Multimode |
| Transceiver type | Fixed | Fixed |

**Table 25: Optical Interface Support for SONET/SDH OC3c/STM1 PICs** *(continued)*

| Parameter | Intermediate Reach | Multimode |
|---|---|---|
| Standard | Telcordia GR-253 | Multivendor agreement |
| Maximum distance | SMF cable: 9.3 miles/15 km | MMF cable: 1.2 miles/2 km |
| Transmitter wavelength | 1260 through 1360 nm | 1270 through 1380 nm |
| Average launch power | –15 through –8 dBm | –20 through –14 dBm |
| Receiver saturation | –8 dBm | –14 dBm |
| Receiver sensitivity | –28 dBm | –30 dBm |

# SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP




**Left: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1); Right: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)**

| | |
|---|---|
| **Software release** | ■ 4-port: JUNOS 8.4 and later (Type 1)<br>■ 4-port: JUNOS 8.3 and later (Type 2) |
| **Description** | ■ Rate-selectable using one of the following rates:<br>  ■ 1-port OC12<br>  ■ 1-port OC12c<br>  ■ 4-port OC3c<br>■ Power requirement: 0.40 A @ 48 V (19 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ Optical diagnostics and related alarms<br>■ Per-port SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Duplex LC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 26 on page 89 and Table 27 on page 90<br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

**Table 26: Optical Interface Support for SONET/SDH OC3/STM1 (Multi-Rate) PICs Configured at an OC3/STM1 Rate**

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC3-SR | SFP-OC3-IR | SFP-OC3-LR |

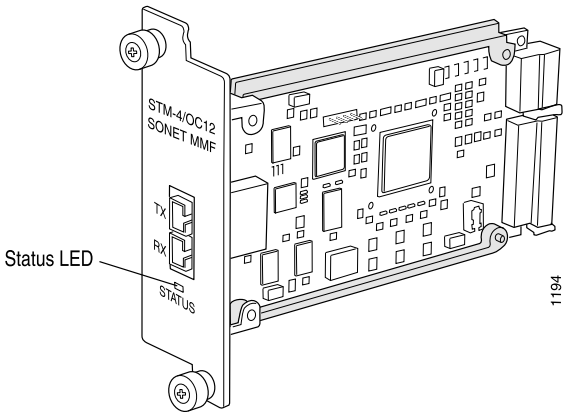
**Table 26: Optical Interface Support for SONET/SDH OC3/STM1 (Multi-Rate) PICs Configured at an OC3/STM1 Rate** *(continued)*

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | MMF cable: 1.2 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Multivendor agreement | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1270 through 1380 nm | 1261 through 1360 nm | 1263 through 1360 nm |
| Average launch power | –20 through –14 dBm | –15 through –8 dBm | –5 through 0 dBm |
| Receiver saturation | –14 dBm | –8 dBm | –10 dBm |
| Receiver sensitivity | –30 dBm | –28 dBm | –34 dBm |

**Table 27: Optical Interface Support for SONET/SDH OC3/STM1 (Multi-Rate) PICs Configured at an OC12/STM4 Rate**

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC12-SR | SFP-OC12-IR | SFP-OC12-LR |
| Optical interface | Single-mode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1261 through 1360 nm | 1274 through 1356 nm | 1280 through 1335 nm |
| Average launch power | –15 through –8 dBm | –15 through –8 dBm | –3 through +2 dBm |
| Receiver saturation | –8 dBm | –8 dBm | –8 dBm |
| Receiver sensitivity | –23 dBm | –28 dBm | –28 dBm |

# SONET/SDH OC12c/STM4 PIC



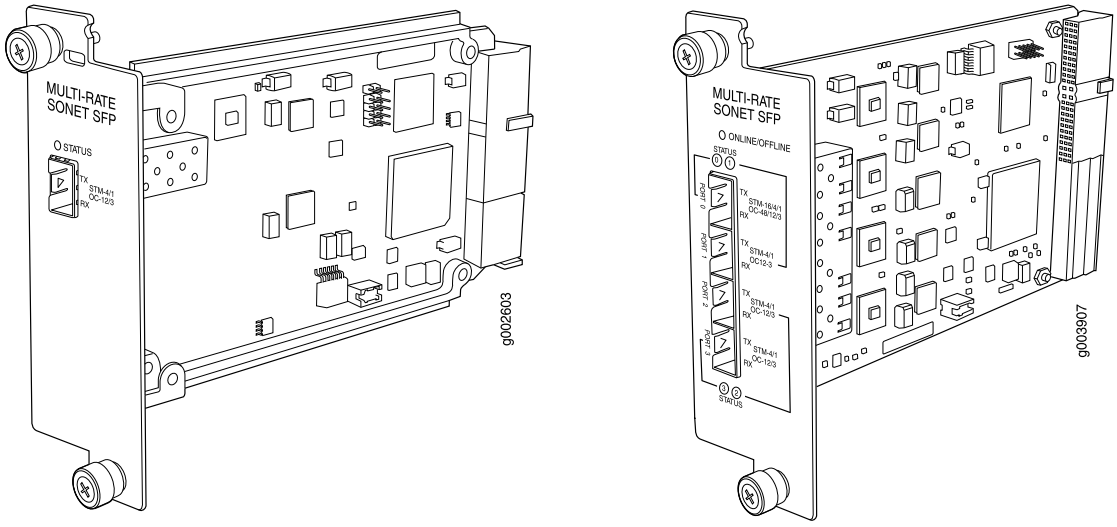

| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ One OC12 port<br>■ Power requirement: 0.23 A @ 48 V (10.8 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |
| **Software features** | ■ SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ Duplex SC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 28 on page 93<br><br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |

| | |
|---|---|
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |
| **Alarms, errors, and events** | ■ SONET alarms:<br>■ Alarm indication signal—line (AIS-L)<br>■ Alarm indication signal—path (AIS-P)<br>■ Bit error rate signal degrade (BERR-SD)<br>■ Bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity (BIP) error B1<br>■ Bit interleaved parity (BIP) error B2<br>■ Bit interleaved parity (BIP) error B3<br>■ Loss of frame (LOF)<br>■ Loss of pointer (LOP-P)<br>■ Loss of signal (LOS)<br>■ Far-end bit error: remote error indication—line (REI-L) (CV-LFE)<br>■ Far-end bit error: remote error indication—path (REI-P) (CV-PFE)<br>■ Payload mismatch (path label mismatch) (PLM-P)<br>■ Payload unequipped (unequipped STS at path level) (UNEQ-P)<br>■ Remote defect indication—line (RDI-L)<br>■ Remote defect indication—path (RDI-P)<br>■ SDH alarms:<br>■ Multiplex section alarm indication signal (MS-AIS)<br>■ Administrative unit alarm indication signal (AU-AIS)<br>■ Bit error rate signal degrade (BERR-SD)<br>■ Bit error rate signal fail (BERR-SF)<br>■ Bit interleaved parity (BIP) error B1<br>■ Bit interleaved parity (BIP) error B2<br>■ Bit interleaved parity (BIP) error B3<br>■ Loss of frame (LOF)<br>■ Loss of pointer (HP-LOP)<br>■ Loss of signal (LOS)<br>■ Multiplex section remote error indication (MS-REI)<br>■ Higher path label mismatch (HP-PLM)<br>■ Higher path unequipped (HP-UNEQ)<br>■ Multiplex section remote defect indication (MS-RDI)<br>■ Higher path remote defect indication (HP-RDI)<br>■ Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)<br>■ Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) |

**Table 28: Optical Interface Support for SONET/SDH OC12c/STM4 PICs**

| Parameter | Intermediate Reach | Multimode |
|---|---|---|
| Optical interface | Single-mode | Multimode |
| Transceiver type | Fixed | Fixed |
| Standard | Telcordia GR-253 | Multivendor agreement |
| Maximum distance | SMF cable: 9.3 miles/15 km | MMF cable: 546.8 yards/500 m |
| Transmitter wavelength | 1274 through 1356 nm | 1270 through 1380 nm |
| Average launch power | –15 through –8 dBm | –20 through –14 dBm |
| Receiver saturation | –8 dBm | –14 dBm |
| Receiver sensitivity | –28 dBm | –26 dBm |

# SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP




**Left: 1-port SONET/SDH OC12/STM4 (Multi-Rate) PIC; Right: 4-port SONET/SDH OC12/STM4 (Multi-Rate) PIC**

| | |
|---|---|
| **Software release** | ■ 1-port: JUNOS 8.4 and later (Type 1)<br>■ 4-port: JUNOS 8.3 and later (Type 2) |
| **Description** | ■ 1-port: Rate-selectable using one of the following rates:<br>  ■ 1-port OC3<br>  ■ 1-port OC12<br>  ■ 1-port OC12c<br>■ 4-port: Rate-selectable using one of the following rates:<br>  ■ 1-port OC12<br>  ■ 1-port OC48<br>  ■ 1-port OC48c<br>  ■ 4-port OC3c<br>  ■ 4-port OC12c<br>■ Power requirement:<br>  ■ 1-port: 0.20 A @ 48 V (9.5 W)<br>  ■ 4-port: 0.40 A @ 48 V (19 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |

| | |
|---|---|
| **Software features** | ■ Optical diagnostics and related alarms<br>■ Per-port SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Duplex LC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 29 on page 96, Table 30 on page 97, and Table 31 on page 97<br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

**Table 29: Optical Interface Support for SONET/SDH OC12/STM4 (Multi-Rate) PICs Configured at an OC3/STM1 Rate**

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC3-SR | SFP-OC3-IR | SFP-OC3-LR |

**Table 29: Optical Interface Support for SONET/SDH OC12/STM4 (Multi-Rate) PICs Configured at an OC3/STM1 Rate** *(continued)*

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | MMF cable: 1.2 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Multivendor agreement | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1270 through 1380 nm | 1261 through 1360 nm | 1263 through 1360 nm |
| Average launch power | –20 through –14 dBm | –15 through –8 dBm | –5 through 0 dBm |
| Receiver saturation | –14 dBm | –8 dBm | –10 dBm |
| Receiver sensitivity | –30 dBm | –28 dBm | –34 dBm |

**Table 30: Optical Interface Support for SONET/SDH OC12/STM4 (Multi-Rate) PICs Configured at an OC12/STM4 Rate**

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC12-SR | SFP-OC12-IR | SFP-OC12-LR |
| Optical interface | Single-mode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1261 through 1360 nm | 1274 through 1356 nm | 1280 through 1335 nm |
| Average launch power | –15 through –8 dBm | –15 through –8 dBm | –3 through +2 dBm |
| Receiver saturation | –8 dBm | –8 dBm | –8 dBm |
| Receiver sensitivity | –23 dBm | –28 dBm | –28 dBm |

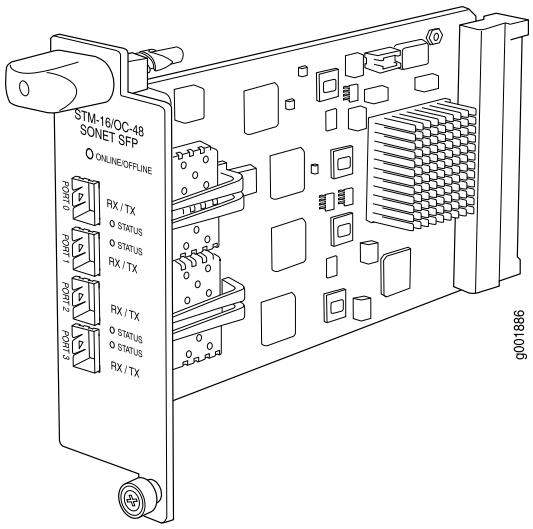
**Table 31: Optical Interface Support for SONET/SDH OC12/STM4 (Multi-Rate) PICs Configured at an OC48/STM16 Rate**

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver model number | SFP-OC48-SR | SFP-OC48-IR | SFP-OC48-LR |
| Optical interface | Single-mode | Single-mode | Single-mode |

**Table 31: Optical Interface Support for SONET/SDH OC12/STM4 (Multi-Rate) PICs Configured at an OC48/STM16 Rate** *(continued)*

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 49.71 miles/80 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1266 through 1360 nm | 1260 through 1360 nm | 1500 through 1580 nm |
| Average launch power | –10 through –3 dBm | –5 through 0 dBm | –2 through +3 dBm |
| Receiver saturation | –3 dBm | 0 dBm | –9 dBm |
| Receiver sensitivity | –18 dBm | –18 dBm | –28 dBm |

# SONET/SDH OC48c/STM16 PIC with SFP




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four OC48 ports<br>■ Power requirement: 0.86 A @ 48 V (41.4 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing on the 1-port PIC<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |
| **Software features** | ■ Optical diagnostics and related alarms<br>■ SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |

| | |
|---|---|
| **Cables and connectors** | You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Duplex LC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 32 on page 101<br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

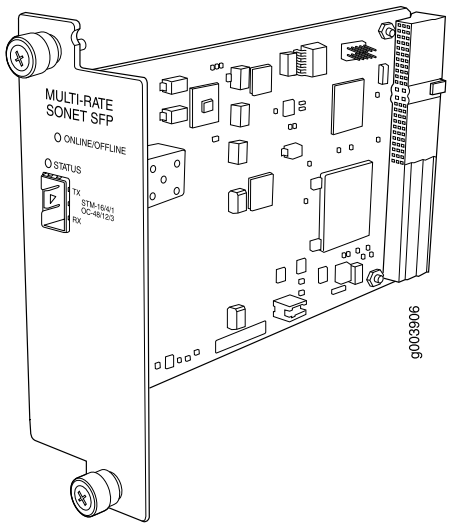
**Table 32: Optical Interface Support for SONET/SDH OC48c/STM16 PICs with SFP**

| Parameter | Short Reach (SR) | Intermediate Reach (IR) | Long Reach (LR) |
|---|---|---|---|
| Optical interface | Single-mode | Single-mode | Single-mode; compatible with 1550-nm single-mode LR |
| Transceiver type | SFP | SFP | SFP |

**Table 32: Optical Interface Support for SONET/SDH OC48c/STM16 PICs with SFP** *(continued)*

| Parameter | Short Reach (SR) | Intermediate Reach (IR) | Long Reach (LR) |
|---|---|---|---|
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 49.71 miles/80 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253—L-16.3 |
| Transmitter wavelength | 1266 through 1360 nm | 1260 through 1360 nm | 1500 through 1580 nm |
| Average launch power | –10 through –3 dBm | –5 through 0 dBm | –2 through +3 dBm |
| Receiver saturation | –3 dBm | 0 dBm | –9 dBm |
| Receiver sensitivity | –18 dBm | –18 dBm | –28 dBm |

# SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP




| | |
|---|---|
| **Software release** | ■ JUNOS 8.3 and later (Type 2) |
| **Description** | ■ Rate-selectable using one of the following rates:<br>■ 1-port OC3c<br>■ 1-port OC12<br>■ 1-port OC12c<br>■ 1-port OC48<br>■ 1-port OC48c<br>■ Power requirement: 0.20 A @ 48 V (9.5 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |
| **Software features** | ■ Optical diagnostics and related alarms<br>■ Per-port SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>■ High-Level Data Link Control (HDLC)<br>■ Frame Relay<br>■ Circuit cross-connect (CCC)<br>■ Translational cross-connect (TCC)<br>■ Point-to-Point Protocol (PPP) |

| | |
|---|---|
| **Cables and connectors** | You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.<br>■ Duplex LC/PC connector (Rx and Tx)<br>■ Optical interface support—See Table 33 on page 105, Table 34 on page 106, and Table 35 on page 106<br><br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

**Table 33: Optical Interface Support for SONET/SDH OC48/STM16 (Multi-Rate) PICs Configured at an OC3/STM1 Rate**

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC3-SR | SFP-OC3-IR | SFP-OC3-LR |

**Table 33: Optical Interface Support for SONET/SDH OC48/STM16 (Multi-Rate) PICs Configured at an OC3/STM1 Rate** *(continued)*

| Parameter | Multimode | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Optical interface | Multimode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | MMF cable: 1.2 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Multivendor agreement | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1270 through 1380 nm | 1261 through 1360 nm | 1263 through 1360 nm |
| Average launch power | –20 through –14 dBm | –15 through –8 dBm | –5 through 0 dBm |
| Receiver saturation | –14 dBm | –8 dBm | –10 dBm |
| Receiver sensitivity | –30 dBm | –28 dBm | –34 dBm |

**Table 34: Optical Interface Support for SONET/SDH OC48/STM16 (Multi-Rate) PICs Configured at an OC12/STM4 Rate**

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-1) |
|---|---|---|---|
| Transceiver model number | SFP-OC12-SR | SFP-OC12-IR | SFP-OC12-LR |
| Optical interface | Single-mode | Single-mode | Single-mode |
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 24.85 miles/40 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1261 through 1360 nm | 1274 through 1356 nm | 1280 through 1335 nm |
| Average launch power | –15 through –8 dBm | –15 through –8 dBm | –3 through +2 dBm |
| Receiver saturation | –8 dBm | –8 dBm | –8 dBm |
| Receiver sensitivity | –23 dBm | –28 dBm | –28 dBm |

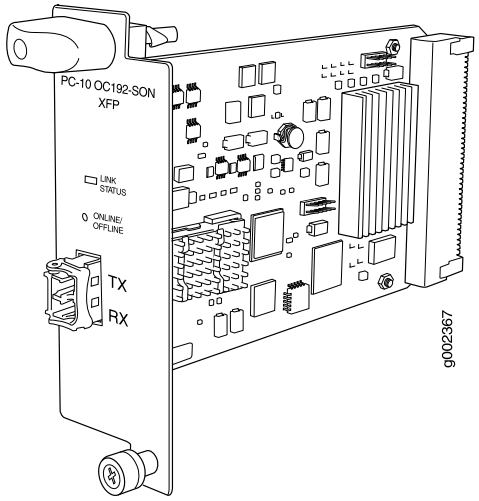
**Table 35: Optical Interface Support for SONET/SDH OC48/STM16 (Multi-Rate) PICs Configured at an OC48/STM16 Rate**

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver model number | SFP-OC48-SR | SFP-OC48-IR | SFP-OC48-LR |
| Optical interface | Single-mode | Single-mode | Single-mode |

**Table 35: Optical Interface Support for SONET/SDH OC48/STM16 (Multi-Rate) PICs Configured at an OC48/STM16 Rate** *(continued)*

| Parameter | Short Reach (SR-1) | Intermediate Reach (IR-1) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver type | SFP | SFP | SFP |
| Maximum distance | SMF cable: 1.24 miles/2 km | SMF cable: 9.3 miles/15 km | SMF cable: 49.71 miles/80 km |
| Standard | Telcordia GR-253 | Telcordia GR-253 | Telcordia GR-253 |
| Transmitter wavelength | 1266 through 1360 nm | 1260 through 1360 nm | 1500 through 1580 nm |
| Average launch power | –10 through –3 dBm | –5 through 0 dBm | –2 through +3 dBm |
| Receiver saturation | –3 dBm | 0 dBm | –9 dBm |
| Receiver sensitivity | –18 dBm | –18 dBm | –28 dBm |

# SONET/SDH OC192c/STM64 PIC with XFP




| | |
|---|---|
| **Software release** | ■ JUNOS 8.3 and later (Type 3) |
| **Description** | ■ One OC192 port<br>■ Power requirement: 0.52A @ 48 V (25 W) |
| **Hardware features** | ■ Multiplexing and demultiplexing<br>■ Rate policing on input<br>■ Rate shaping on output<br>■ Packet buffering, Layer 2 parsing |
| **Software features** | ■ SONET/SDH framing<br>■ Link aggregation<br>■ Alarm and event counting and detection<br>■ Dual-router automatic protection switching (APS)<br>■ Multiprotocol Label Switching (MPLS) fast reroute<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Translational cross-connect (TCC)<br>  ■ Point-to-Point Protocol (PPP) |

| | |
|---|---|
| **Cables and connectors** | ■ Duplex LC connector (Rx and Tx)<br>■ Optical interface support—See Table 36 on page 110<br><br>**NOTE:** To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the request chassis pic offline command in the *JUNOS System Basics and Services Command Reference*. |
| **LEDs** | One tricolor LED per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

**Alarms, errors, and events**

- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path label mismatch) (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Multiplex section alarm indication signal (MS-AIS)
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- Errored seconds (ES-S, ES-L, ES-P), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P)

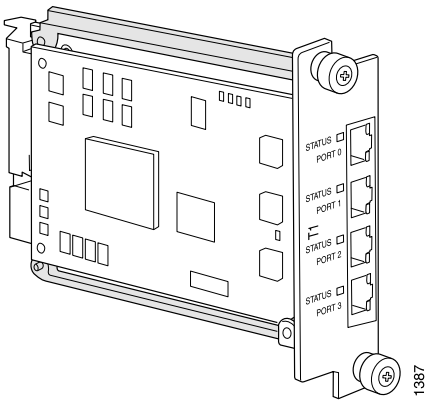
**Table 36: Optical Interface Support for SONET/SDH OC192 PICs**

| Parameter | Short reach (SR-1) | Intermediate Reach (IR-2) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver model number | XFP-10G-L-OC192-SR1 | XFP-10G-E-OC192-IR2 | XFP-10G-Z-OC192-LR2 |
| Optical interface | Single-mode | Single-mode | Single-mode |

**Table 36: Optical Interface Support for SONET/SDH OC192 PICs** *(continued)*

| Parameter | Short reach (SR-1) | Intermediate Reach (IR-2) | Long Reach (LR-2) |
|---|---|---|---|
| Transceiver type | XFP | XFP | XFP |
| Standard | Telcordia GR-253 OC192 SR1 | Telcordia GR-253 OC192 IR2 | Telcordia GR-253 OC192 LR2 |
| Maximum distance | SMF cable: 6.21 miles/10 km | SMF cable: 24.8 miles/40 km; distances greater than 30 km are considered to be engineered links. | SMF cable: 49.71 miles/80 km |
| Transmitter wavelength | 1290 nm through 1330 nm | 1530 nm through 1565 nm | 1530 nm through 1565 nm |
| Average launch power | –6 through –1 dBm | –1.0. through 2 dBm | 0 through 4 dBm |
| Receiver saturation | –1.0 dBm | –1.0 dBm | –7 dBm |
| Receiver sensitivity | –11 dBm | –14 dBm | –24 dBm |

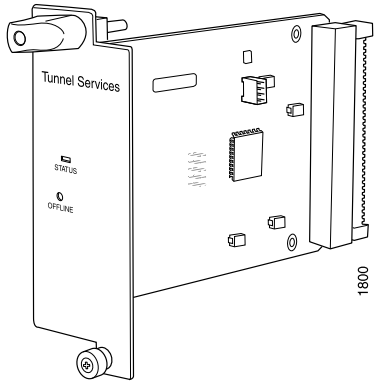
# T1 PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Four T1 ports<br>■ Power requirement: 0.08 A @ 48 V (3.7 W)<br>■ Supports clear channel T1 per port (1.544 Mbps per channel)<br>■ Supports attenuation up to –12 dBm |
| **Hardware features** | ■ Per-port loop timing<br>■ Onboard DSU functionality for T1 connectivity |
| **Software features** | ■ ESF and SF framing<br>■ B8ZS and AMI coding<br>■ ESF CSU counters, WRT impairments, and CRC checking<br>■ Local DS1 line loopback, remote line loopback<br>■ Configurable clock source—internal or loop<br>■ Encapsulations:<br>  ■ High-Level Data Link Control (HDLC)<br>  ■ Frame Relay<br>  ■ Circuit cross-connect (CCC)<br>  ■ Point-to-Point Protocol (PPP) |
| **Cables and connectors** | ■ 100-ohm RJ-48 connector |
| **LEDs** | One tricolor per port:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

| | |
|---|---|
| **Alarms, errors, and events** | ■ Alarm indication signal (AIS)<br>■ Bipolar violations<br>■ Excessive zeros<br>■ Far-end block errors (FEBE, E-bit errors)<br>■ Loss of frame (LOF), Loss of signal (LOS)<br>■ Yellow alarm bit (X-bit) disagreements |

# Tunnel Services PIC




| | |
|---|---|
| **Software release** | ■ JUNOS 8.0R2 and later (Type 1, Type 2, and Type 3)<br><br>**NOTE:** This PIC is not supported in JUNOS Release 8.1R1. |
| **Description** | ■ Power requirement: 0.07 A @ 48 V (3.4 W) |
| **Hardware features** | ■ Loopback function that encapsulates and de-encapsulates packets<br>■ OC12/STM4 tunneling bandwidth on FPC1; OC48/STM16 tunneling bandwidth on FPC2; OC192/STM64 tunneling bandwidth on FPC3 |
| **Software features** | For a list of the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*.<br>■ IP-IP unicast tunneling<br>■ GRE unicast tunneling<br>■ PIM sparse mode unicast tunneling |
| **LEDs** | One tricolor:<br>■ Off—Not enabled<br>■ Green—Online with no alarms or failures<br>■ Amber—Online with alarms for remote failures<br>■ Red—Active with a local alarm; router has detected a failure |

Appendix A

# High Availability Features

High availability features include Routing Engine redundancy, graceful Routing Engine switchover (GRES), nonstop bridging, nonstop active routing, graceful restart for routing protocols, Virtual Router Redundancy Protocol (VRRP), and unified in-service software upgrade (ISSU). Some high availability features are not supported by all platforms and all PICs. For information about the first supported JUNOS release for these features by PIC and platform, see the *JUNOS High Availability Configuration Guide*.

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10 March 2008—530-024399-01. Revision 1. Added new transceiver, XENPAK-OTN, for 10-Gigabit Ethernet PIC with XENPAK.
1 February 2008—530-022467-01. Revision 2. Removed SONET/SDH OC3c/STM1 PIC (SMF-IR), SONET/SDH OC12c/STM4 PIC (SMF-IR), SONET/SDH OC12c/STM4 PIC (MM) and SONET/SDH OC48c/STM16 PIC with SFP.
15 September 2007—530-022467-01. Revision 1. Added 8-port Gigabit Ethernet IQ2 Type 3 PIC. Removed SONET/SDH OC192c/STM64 PIC.
29 June 2007—530-020809-01. Revision 1. Added SONET/SDH OC3/STM1 and OC12c/STM4 (Multi-Rate) Type 1 PICs. Added EIA-530 PIC.
30 March 2007—530-020469-01. Revision 1. Added MultiServices 100 and 500 PICs. Added SONET/SDH OC192c/STM64 PIC with XFP, SONET/SDH OC3 (Multi-Rate) PIC with SFP, SONET/SDH OC12 (Multi-Rate) PIC with SFP, and SONET/SDH OC48 (Multi-Rate) PIC with SFP. Added connectors to the supported cFPCs table.
12 January 2007—530-017885-01. Revision 1. Added MultiServices 400 PIC for JUNOS Release 8.2. Removed product reclamation and recycling.
26 October 2006—530-016112-01. Revision 2. Updated FPC throughput numbers.
05 October 2006—530-016112-01. Revision 1.

The information in this document is current as of the date listed in the revision history.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. The JUNOS software has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.